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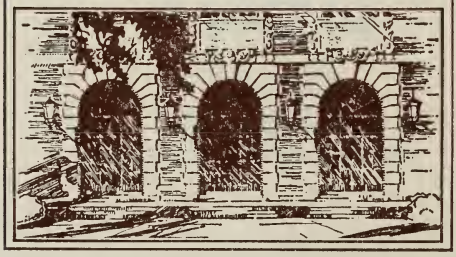

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE:

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S.

AUTHORIZED AMERICAN REPRINT, VOLUME V.—JULY, 1869, TO JANUARY, 1870.

NEW YORK:

W. A. TOWNSEND & ADAMS, PUBLISHERS.

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VOLUME V., AMERICAN REPRINT,

BEING PARTS OF

VOLUMES XIX., XX., VIZ. NUMBERS 492-518,

OF THE ENGLISH EDITION.

THE NEW YORK PRINTING COMPANY,
81, 83, *and* 85 *Centre Street,*
NEW YORK.

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THE CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

Volume V. July, 1869.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.

BY J. NORMAN LOCKYER.*

No. IV.

I BEG to lay before the Royal Society, very briefly, the results of observations made on the 11th inst. in the neighbourhood of a fine spot, situated not very far from the sun's limb.

I. Under certain conditions the C and F lines may be observed *bright on the sun*, and in the spot spectrum also, as in prominences or in the chromosphere.

II. Under certain conditions, although they are not observed as bright lines, the corresponding Fraunhofer lines are blotted out.

III. The accompanying changes of refrangibility of the lines in question show that the absorbing material moves upwards and downwards as regards the radiating material, and that these motions may be determined with considerable accuracy.

IV. The bright lines observable in the ordinary spectrum are sometimes interrupted by the spot spectrum, *i. e.* they are only visible in those parts of the solar spectrum near, and away from, spots.

V. The C and F lines vary excessively in thickness over and near a spot, and on the 11th in the deeper portion of the spot they were much thicker than usual.

VI. Stars, in the spectrum of which the absorption lines of hydrogen are absent, may either have their chromospheric light radiated from beyond the limb just balanced by the light absorbed by the chromosphere on the disk, or they may come under the condition referred to in II., either absolutely or on the average.

ON THE COMPOSITION OF THE MILK OF THE SOW.

BY PROFESSOR CHARLES A. CAMERON, PH.D., M.D., ANALYST TO THE CITY OF DUBLIN.

WITH the exception of the milk of the sow, the lacteal secretions of the domesticated animals have been repeatedly analysed. Scheven appears to have been the only chemist who has published an analysis of sow's milk; but his results are so different from those of an analysis of sow's milk made by myself that I am induced to publish my analysis. In the sow's milk examined by me there was 6 per cent of fat, whilst in a specimen analysed by Scheven, the proportion of that constituent was under 2 per cent. It is not very easy to procure a specimen of sow's milk, and perhaps this is the reason why it has not hitherto been frequently analysed. I endeavoured on several occasions to obtain a small quantity, but the sows appealed to at my instigation were obdurate—they would not yield a drop, even when subjected to the dexterous manipulation of the most skilful dairymaids. At length, about two months ago, a specimen of sow's milk came into my possession; I am indebted for it to Thomas Baldwin, Esq., the Superintendent of Irish Agricultural Schools, and Director of the Glasnevin Government Model Farm. On submitting it to analysis, the following results were obtained:—Specific gravity, 1·041; colour, white, without any bluish shade; flavour very rich, resembling that of the skimmings of cow's milk; reaction, very faint alkaline. 100 parts contained:—

Water	81·80
Fats	6·00
Casein and other nitrogenous matters,	5·30
Lactin	6·07
Mineral Matter	0·83
	100·00
Total solids	18·20

The analysis was conducted as follows:—

a. A weighed portion of the milk was acidulated with a little acetic acid to prevent the formation of a skin, mixed with pulverised quartz (which had been previously boiled in hydrochloric acid, washed, and ignited), and evaporated in the water-bath to dryness.

b. The residue was treated with strong ether, by which the fats were dissolved. The ether was then evaporated and the residue of fats weighed. The fats were finally burned in a platinum capsule, and left no residue, proving the absence of mineral matter or casein.

c. The substance from which the fats had been removed was subjected to a nitrogen combustion, and from the amount of nitrogen obtained the proportion of casein and other nitrogenous substances present in the milk was estimated in the usual manner.

d. The proportion of lactin was found by difference, and also by the sulphate of copper method.

e. Determination of the mineral matter (ash). Five grammes of the milk were evaporated to dryness and the residue burned in oxygen gas. The amount of solid matter obtained by desiccating a weighed quantity of milk was slightly in excess of the sum of the weights of the individual constituents. It must, however, be borne in mind that the mineral matter in the nitrogenous substances is weighed twice—first, as a constituent of the casein, and, secondly, as an ingredient of the ash. Its amount, however, is trifling.

A comparison of the milk of the sow with that of the cow and other animals will show how extremely rich is the former.

Composition of the Milk of different Animals.

1,000 parts contain:—

	Water.	Butter.	Cheesy Matter.	Sugar.	Mineral Matter.
Woman	889·08	26·66	39·30	43·68	1·30
Cow	864·20	31·30	48·80	47·70	6·00
Goat	844·90	56·87	35·14	36·91	6·18
Ewe	832·32	51·31	69·78	39·43	7·16
Mare	904·30	24·36	33·35	32·76	5·23
Ass	890·12	18·53	35·65	50·46	5·24
Sow	818·00	60·00	53·00	60·70	8·30

* Read before the Royal Society, April 28th, 1869.

[English Edition, Vol. XIX., No. 492, page 217.]

Proportions of Solids and Water in different kinds of Milk.

	Woman.	Cow.	Goat.	Ewe.	Mare.	Ass.	Sow.
Water	889·08	864·20	844·90	832·32	904·30	890·12	818·00
Solids	110·92	135·80	155·10	167·68	95·70	109·88	182·00
	1000·00	1000·00	1000·00	1000·00	1000·00	1000·00	1000·00

The following particulars relative to the sow whose milk I have described were furnished to me by Mr. Baldwin:—"The sow whose milk I sent you is a pure Berkshire; she had pigged six days before the milk was withdrawn; she has a fair litter, and is an average nurse. She is receiving the sort of diet suited to her condition—viz., a mixture of small and damaged potatoes, pulped roots, and a little grains, the potatoes and roots being subjected to the action of steam. The food is not too rich, but just sufficient to keep herself and her young in a good healthy condition."

Pig's milk is extremely rich, containing, as it does, nearly 50 per cent more nutritive matter than is found in that of the cow. It is not unlikely that in certain forms of disease where a milk diet is prescribed the use of so concentrated a liquid food might prove serviceable.

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ON SOME APPLICATIONS OF ELECTRICITY TO NAVAL AND MILITARY PURPOSES.*

BY F. A. ABEL, F.R.S., FOR. SEC. C.S.

The applications which electric science has received within the last few years in connection with the military and naval services are various and important. The employment of the electric light for signalling and reconnoitring purposes; the permanent establishment of telegraphic equipments by which an army in the field or at a siege is maintained in the most intimate communication with the directing powers; the employment of the electric signalling arrangements in ships of war, and the accurate investigation of the ballistic force of gunpowder and other explosive agents, are among the uses to which electricity has been put in connection with war purposes; but the earliest application, and one of the most important and extensive —one, moreover, possessing great interest from industrial points of view—is the employment of electricity as an agent for exploding land and submarine mines.

The possibility of applying the electric spark to the ignition of charges of gunpowder suggested itself both to Franklin, in 1751, and to Priestley in 1767; but it was not until some years after the discovery of the electric pile by Volta, that serious attempts were made to apply electricity to mining and military purposes. The first practical application of the voltaic battery in this direction was made little more than thirty years ago by French military Engineers; a few years afterwards that agent was successfully applied in this country in connection with important blasting operations, such as the destruction of Round Down Cliff at Dover, and the removal of the wrecks of the *Royal George* and *Edgar* at Spithead. The general method of operation then pursued was adhered to by military Engineers in this country until very recently, and is, in fact, still occasionally employed, though it has been in great measure superseded by other systems which present very important advantages. It consists in inserting into the charge of gunpowder a short piece of thin wire, composed of a metal of inferior conducting power, such as iron or platinum, and placing this wire into connection with the circuit wires of the battery. The resistance offered to the passage of the current gives rise to the development of heat, the intensity of which is regulated by the conducting power and the length and thickness of the wire. The latter may, in this way, be raised to a red heat, or even fused; and thus, by completing circuit through the wire at the desired moment, a charge of powder may be inflamed. A number of charges may be simultaneously exploded by introducing several pieces of thin wire into the circuit.

Although the employment of a voltaic current of low tension presents obvious and great advantages over old systems of igniting charges by trains or slow-burning fuses, its application to military purposes is attended with some difficulty and uncertainty, arising out of the want of uniformity of action of the same voltaic arrangements at different periods, the difficulties attending the transport and proper preservation of the battery and materials required for its use, the dependence for success upon care and experience in preparing and preserving the batteries, and the very considerable increase which it is necessary to make in the power of the battery when the operations to be performed involve the simultaneous explosion of a number of charges, or the ignition of gunpowder at very considerable distances from the battery.

For these reasons, soon after the first successful application of voltaic electricity to mining purposes, the attention of military Engineers on the Continent, and of others here and abroad who were specially interested in operations of this kind, became directed to the possibility of rendering electricity of high tension available for exploding purposes, whereby voltaic batteries, for mining operations, might be greatly reduced in size, if not altogether dispensed with.

In 1853, a Spanish officer, Colonel Verdu, associated himself with M. Ruhmkorff in experiments on the application of electro-magnetic induction coils to the explosion of gunpowder. The success of their experiments led Colonel Verdu to pursue them further in Spain, where he soon succeeded in firing six mines simultaneously by one element of Bunsen's battery, at a distance of upwards of three hundred yards, through the agency of the Ruhmkorff coil. The mode of operating and difficulties which Colonel Verdu had to overcome will be presently described. While the success of these operations led the military Engineers in Spain, France, and Russia to pursue the development of the application of electro-magnetic induction instruments to exploding purposes, a committee of Austrian military Engineers (of which Baron von Ebner was from the first a most distinguished member) was labouring to apply frictional electricity to military uses as an exploding agent, having come to the conclusion that the electro-magnetic induction apparatus was too complicated and too greatly susceptible of derangement for military uses. But little success had up to that time attended attempts to apply frictional electricity to this purpose. In 1831, Moses Shaw, of New York, succeeded in exploding several mines simultaneously by means of frictional electricity, but was foiled in his attempts to apply this agent to practical purposes, by the fact that he could not conduct operations with any chance of success except in very dry weather. Somewhat more promising results attended several attempts in Germany between 1842 and 1845; but the prospect of practical success was still not encouraging when the Austrian Committee of Engineer Officers took the matter in hand, and eventually produced a portable

* A lecture delivered before the Royal Institution of Great Britain, March 12, 1869.

glass frictional electric machine, which, when in good working order, furnished results surpassing those which had been obtained with volta-induction apparatus. Some very extensive operations were conducted with this machine; thus, fifty land charges and, afterwards, thirty-six submarine charges, were simultaneously exploded. Even, however, with all the precautions adopted, the machine was still too seriously affected by damp to be thoroughly serviceable for military purposes. But the persevering labours of Baron von Ebner eventually resulted in the production of an electric machine which was almost entirely free from the objections hitherto attached to this form of apparatus.

While the progress just indicated was being made in different parts of the Continent in the application of electricity to mining operations, but little attention was directed in this country to effecting improvements in the utilisation of electricity for military mining purposes. In 1855, however, Sir C. Wheatstone directed the attention of Field-Marshal Sir John F. Burgoyne to the importance of instituting an experimental inquiry into the relative advantages of different sources of electricity of tension as agents for exploding gunpowder. The Ordnance Select Committee, of whom Sir C. Wheatstone and Mr. Abel were then members, were consequently instructed to pursue this inquiry; and a series of investigations was carried out, in the first instance, to a working branch of the Committee, and subsequently by Mr. Abel at Woolwich and Chatham, the results of which were eventually embodied in a report presented by the above-mentioned gentlemen to the Secretary of State for War in 1860. Since then Mr. Abel, as a member of the Government Committee on Floating Obstructions, has continued systematic investigations on the applications of electricity to the explosion of mines, and especially to submarine operations, and considerable improvements and simplifications of the arrangements and appliances have resulted. Some advance has also been made on the Continent in this subject, and during the last two or three years our military Engineers have acknowledged in the most practical manner the advantages to be derived from the use of electricity of tension as the agent for exploding mines, by gradually, and to a very great extent, abandoning the old system of operation, and by devoting considerable attention to the practical elaboration of the new systems.

The following is an outline of the results obtained up to the present day with different classes of instruments which furnish electricity of tension.

It has been stated that Colonel Verdu succeeded, in 1853, in exploding several mines simultaneously by means of a Ruhmkorff induction coil. The ignition of the gunpowder was effected in these experiments by introducing one or more small but complete interruptions into the circuit, across which the electric spark of high tension would leap upon the current being passed. This spark will inflame gunpowder, but not very readily, although its production is attended with development of heat considerably in excess of that required; the reason being that powder requires for ignition either the close proximity of a considerable heated surface, or the continuous application to heat for a brief period, while the disruptive discharge from an induction coil consists of a series of instantaneous discharges following each other in very rapid succession. Hence a charge of gunpowder is not always instantaneously fired when the spark is passed; indeed, unless the powder be closely confined round the wire terminals between which the spark passes, it is sometimes dispersed by the mechanical action of the spark without being exploded; and when a succession of sparks is passed simultaneously through a number of charges, it frequently happens that only a few are exploded, in which some of the grains happened to be in positions or conditions more favourable with reference to the source of heat than in other instances, where the powder would escape ignition. Colonel Verdu succeeded in increasing the certainty of simultaneous ignition of several charges, by surrounding the wire terminals with a substance much more readily inflamed than powder—the fulminate of mercury. Another source of difficulty in effecting the simultaneous ignition of a considerable number of charges by the spark from the coil is the enfeebling effect upon the spark-discharge exerted by a number of successive small interruptions in the circuit. This was to some extent overcome by employing a fuse constructed by Messrs. Statham and Brunton, in which the space between the wire terminals was bridged over with a film of a finely-divided substance—the subsulphide of copper—the conducting power of which is sufficiently great to aid the passage of the electric discharge across the interruption, while it is at the same time readily combustible, and therefore directly promotes the ignition of the powder. Finding that, even with the combined use of this fuse and of fulminate of mercury, the power of the induction coil to explode charges simultaneously was limited, Colonel Verdu adopted the following simple arrangement:—Separate small groups of mines were all connected with earth, and an insulated conducting wire connected each group with a distinct small insulated plate. By bringing these plates in very rapid succession into circuit with the coil machine, the several groups were so rapidly exploded as to produce results somewhat similar to those attainable by the really simultaneous discharge of a considerable number. Not long after this contrivance was adopted by M. Verdu, M. Savare devised another arrangement, whereby a much more rapidly successive discharge of a number of mines was accomplished through the agency of the coil. The metallic circuit which passed to the mines was divided into a number of branches, so that, upon completion of the circuit, the currents, following each other in very rapid succession, would distribute themselves through all the branches with a degree of uniformity regulated by the resistance met with in each branch. Thus, when one or more fuses were interposed in each branch of the circuit, those which happened to offer the greatest facilities for the passage of the current would be first fired, whereupon the escape of electricity in that direction would be interrupted, and the explosion of fuses in the other branches would follow. With the employment of currents following each other with the enormous rapidity with which they pass off from the induction coil machines, the discharge of a number of mines may thus be effected with a rapidity which, practically, has almost the effect of a simultaneous discharge.

The Ruhmkorff coil was used to some extent by the Russians in mining operations during the Crimean war, and some very extensive blasting operations were carried on with its aid at Cherbourg in 1854. A series of experiments was instituted at Woolwich in 1856 with two excellent induction coils, produced by M. Ruhmkorff, in the course of which various descriptions of materials were tried in the fuses, for the purpose of increasing the power of the machine to fire numbers of charges simultaneously. At that time the fulminate of

mercury was found to be the best inflaming agent; but not more than twelve charges were fired simultaneously by means of the most powerful coil available and a battery of twelve cells (without employing Verdu's or Savare's methods of explosions). One defect in this class of instrument was found to be the want of uniform action of one and the same apparatus at different periods; another was the liability to derangement of the machine, especially of the condenser. Far more successful results were afterwards obtained with the same coils and the fuse constructed at a later period of these investigations; fifteen charges were fired simultaneously with a battery of six cells, and fifty charges, arranged in branch-circuit in groups of ten, were exploded with the effect of a simultaneous discharge. These results were obtained with machines produced by Ruhmkorff in 1855; but the improvements since then effected in the construction of this apparatus have reduced to insignificance the results at that time obtained with it. There is no question therefore that the Ruhmkorff coil is available for special operations of considerable magnitude; but in point of simplicity, certainty, and constancy of action, it is far surpassed by other forms of electric instruments, which will be presently noticed.

At the suggestion of Sir Charles Wheatstone, experiments were commenced in 1856 on the application of currents *induced by permanent magnets* to the explosion of gunpowder The first experiments were instituted with a very large and powerful magneto-electric machine, constructed by Mr. Henley, of which the armature, carrying two powerful coils, was suddenly detached from the magnet by means of a lever. A few experiments sufficed to show that the induced current obtained even with this powerful instrument was not adequate to ignite one single charge of gunpowder with certainty. Somewhat better, but still uncertain, results were obtained with Statham's and one or two other forms of fuses existing at that time. A careful investigation was then undertaken by Mr. Abel (with the invaluable assistance of Mr. Brown, of the Chemical Department, Woolwich), into the conditions to be fulfilled in the production of a fuse which should be certain of action with the magneto-electric machine. The results of extensive experiments indicated that a combination of comparatively high conducting power with great susceptibility to ignition appeared to be essential elements of success in a material as the exploding agent in a fuse. The uniform arrangement of the poles or wire terminals in the fuse, the space between which was to be bridged over by the igniting composition, also proved a matter of great importance. A mode of constructing the fuses which ensured perfect uniformity in this respect was ultimately perfected, and has proved quite successful. A very fairly efficient fuse was obtained with the aid of the poles thus arranged, by employing as the igniting agent gunpowder impregnated with a small proportion of calcic chloride, which caused it, upon brief exposure to air, to imbibe moisture sufficient to render the gunpowder highly conducting. It is obvious, however, that, although the fuse itself was hermetically closed when complete, there must be a liability to want of uniformity in the proportion of water absorbed by the powder, and a consequent variation in the conducting power of the latter. Eventually a material was prepared (consisting of the subphosphide of copper, subsulphide of copper, and potassic chlorate) which combined the essentials of perfect certainty of action with very great sensitiveness to ignition. Henley's large magnet fired *three* of these fuses simultaneously with perfect certainty, while a small horse-shoe magnet with revolving armature exploded 25 in divided circuit in exceedingly rapid succession. A combination of six small compound magnets was afterwards employed, with which an exceedingly rapid succession of currents was obtained, and this apparatus exploded twenty-five fuses in divided circuit with a rapidity which to the ear had the effect of an instantaneous explosion. Even the small magneto-electric instruments which are used for medical purposes will explode these fuses with certainty.

The application of magneto-electric machines having been successfully accomplished, a series of experiments was carried on by Mr. Abel, with the valuable aid of Colonel H. Scott, R. E., at Chatham, during the years 1857-58, on the explosion of charges, both land and submarine; and the great advantages of these instruments, as regards simplicity and permanent efficiency, over the voltaic arrangements hitherto used, was fully demonstrated. Very compact but powerful exploding instruments were constructed by Sir C. Wheatstone, and these have for the last seven or eight years received many important applications; thus, the proof of cannon at Woolwich and the firing of guns, from a safe distance, in the numerous experiments at Shoeburyness, is effected by means of Wheatstone's exploder, which is, moreover, an important adjunct in all electro-ballistic experiments, when the operator desires himself to fire a gun at a particular moment. Magneto-electric machines have also been found very useful in connection with blasting operations on land, except in instances when the absolutely simultaneous explosion of a large number of mines is required.

Since the success of Wheatstone's exploders has been fully established, several other forms of magneto-electric machines have been devised, especially on the Continent and in America. Powerful instruments similar to Wheatstone's are manufactured by Siemens and Halske, of Berlin; Markus, of Vienna, has constructed very efficient instruments in which one separation and return of the armature to the magnet are made to explode the charges. The disadvantages of these instruments is that a *succession* of currents cannot be obtained from them as in the case of machines with revolving armatures; hence the number of mines which can be exploded by them in divided circuit is comparatively limited. Mr. Beardslee, an American, has also devised a modification of Wheatstone's exploder, in which the magnets are made to revolve between the armature coils, and which furnishes currents of greater quantity but lower tension than Wheatstone's. The fuse constructed by Mr. Beardslee, for employment with this instrument, is similar in principle of construction to Abel's; but the materials which bridge over the space between the terminals or poles of the fuse are black-lead, with the addition of a minute quantity of some substance, apparently collodion, which adds to the size of the scintillations produced when the current passes, and thus increases the certainty of ignition of the powder which is in close contact with the poles. These fuses are efficient with magneto-electric instruments like that of Mr. Beardslee, but they are much less delicate than the Woolwich fuses, and the number which can be simultaneously exploded is therefore much more limited. Sir C. Wheatstone has also lately constructed more powerful modifications of his original magnetic exploder, which may, at will, be made to furnish currents of greater quantity and lower tension, or to produce the high tension currents. Lastly, Mr. Ladd and Mr. Browning

have produced instruments of comparatively low price, but quite powerful enough for ordinary blasting and quarrying operations. The only obstacle, but a most important one, to the general use of these machines, for the explosion of mines on land and under water is, that very slight defects in the insulation of the conducting wire which leads from the instrument to the mines are quite fatal to its exploding power. In consequence of the high tension of the current developed by these machines, and the small quantity put into circulation by even the most powerful of them, the diversion of the current from its destined course to earth is promoted by the smallest points of escape presented to it; a result which is, moreover, facilitated by the resistance of the fuses in circuit. With care this source of failure can be guarded against in operations on land, but such is not the case with regard to submarine arrangements; while, moreover, minute defects in the coatings of the *submerged* wires, which would hardly influence the results at all on land, completely nullify the exploding power of the machines. Hence magneto-electric instruments are the least reliable of all electric exploding apparatus for submarine purposes.

A few experiments were instituted at Woolwich in 1857 on the employment of *frictional electricity* as an exploding agent, and especially with a small hydro-electric machine constructed for the purpose by Sir William Armstrong. As regards its power of exploding a number of charges simultaneously, when it was in good working order, it far exceeded any other instrument experimented with at that time: one hundred fuses, arranged in a single current, were frequently exploded by its means; but the great uncertainty of its action, and the difficulty of employing it in the field did not afford encouragement for a continuation of experiments with it.

The great difficulties encountered in the Austrian experiments in the attempts to employ glass frictional electric machines as exploding agents for military purposes, led Baron von Ebner to direct his attention to the production of an instrument in the construction of which glass was altogether avoided, and which might therefore be expected to be less subject to atmospheric influences. His labours in this direction were eventually crowned with success; for he found in the hard vulcanised india-rubber (known as ebonite or vulcanite) a dielectric material excellently adapted to the construction of the frictional apparatus; while by employing a sheet of vulcanised india-rubber coated with tinfoil and compactly rolled up he obtained without the use of glass a powerful condenser, or Leyden jar arrangement. The improved machines were constructed in a very compact form (with cases excluding all the working parts from direct exposure to air) by Messrs. Siemens, of Berlin, and Lenoir, of Vienna, who exhibited specimens in England in 1862, at which time the electric machine had already received important applications in the Austrian service, and had been regularly adopted for military uses. Baron von Ebner had also, from the commencement of the Austrian experiments, laboured assiduously at the production of an efficient fuse to be used with electricity of tension; and the Austrian service is indebted to him for a simple and thoroughly serviceable fuse, which, as regards the arrangement of its poles and the character of the igniting composition, may be said to combine the principles of the Statham and Abel fuses. Though less sensitive than the present English service electric fuse, a very considerable number may be exploded in simple circuit by the ebonite electric machine. The power of this apparatus in its portable form is nearly equal to that of the hydro-electric apparatus just now referred to, when the latter is in perfect working order. A far greater number of mines may therefore be simultaneously exploded by its means than by very large batteries or by the most powerful magneto-electric machines hitherto constructed. One hundred of Abel's fuses have frequently been simultaneously exploded with one of the portable machines, and still greater results can be obtained with a larger instrument having a battery of condensers, which was specially constructed for submarine operations by Mr. Becker, at the suggestion of Captain Maury. In very damp weather, when the most perfect glass electric machines would have been useless unless housed in a warm apartment from which the external air was as much as possible excluded, these ebonite machines have been used from time to time throughout the day with very satisfactory results.

Another important advantage which these instruments possess over magneto-electric machines consists in the fact that very considerable defects in the insulation of even submerged conducting wires do not so greatly reduce the power of the current furnished by them as to interfere with the accomplishment by its agency of the most extensive operations under water which are likely to occur in practice. Unfortunately, however, the very circumstance which constitutes its chief advantage, namely, the powerful character of the current of high tension with which it charges an insulated wire, is also a source of serious defect, to be presently noticed, which very greatly limits the applicability of these machines to naval and military purposes.

A class of electrical instruments has been created within the last three years which bids fair to supplant even these very powerful and efficient frictional machines. The instruments in question, of which different forms have been devised by Wheatstone, Wilde, Siemens, and Ladd, have received the generic name of *dynamo-electric machines*, because dynamic force becomes through their agency a direct and powerful source of electricity. In the machines of Siemens, Wheatstone, and Ladd, mechanical power is transformed into electric force without the intervention of permanent magnets. The action of the most simple form of these instruments may be described as follows:—The residual magnetism existing in an electro-magnet suffices to develop an induced current in a rapidly revolving coil armature; this current, reacting upon the electro-magnet, determines the development of powerful magnetism in the latter by the inductive action of its insulated coils; the currents developed by the electro-magnet are consequently in their turn greatly increased in power, and react again upon the armature; and thus an immense accumulation of electric force is accomplished with great rapidity, until, when that accumulation has reached the maximum attainable without detriment to the insulation of the wire coils, a simple interrupting arrangement causes the current to be diverted from the machine to conducting wires, by whose medium it is utilised. The details of the machines vary according to the different plans adopted by the several constructors, but the above explanation applies more particularly to the machines of Messrs. Siemens and Halske, who have been the first to produce a small instrument of this class thoroughly applicable to mining purposes, and which almost

equals in power the ebonite frictional electric machine. Fifty charges, arranged in simple circuit, have been repeatedly exploded, without any failures, by one of these machines; it therefore provides with certainty the power necessary for the most extensive mining or submarine operations, and is at the same time quite free from all disturbing atmospheric influences. Its mechanism is simple, and less easily susceptible of derangement than that of any magneto-electric apparatus, and as it is independent of everything but the application of manual power for the development of its action, it is far superior to the most perfect of these, independently of the fact that it surpasses them all greatly in power. For many important military and mining operations the hand dynamo-electric machines, constructed by Messrs. Siemens and Halske, are therefore unquestionably superior to all other existing apparatus which furnish electricity of tension. This class of instrument, however, shares, to some extent at any rate, one important defect of the frictional-electric machines, which is consequent upon the powerful charges of high-tension electricity sent into conducting wires by their agency. It was observed, in the early experiments of the Austrians with frictional electricity, that if two or more insulated wires which led to distinct mines were situated side by side, in moderately close proximity, even only for comparatively short distances, the charge sent from the machine into one of the wires, with the view of only exploding a particular mine or series, might develop in neighbouring wires, not connected with the machine, a charge of induced electricity of sufficient power to explode the mines connected with those wires. Some results obtained at Chatham and many experiments recently instituted at Woolwich have not only confirmed those observations in Austria, but have shown that means do not at present exist of avoiding this serious defect of powerful charges of high tension. If, therefore, it is necessary to lead separate wires from the point of operation (from the exploding instrument) to different mines or groups which it is desired to explode independently of each other, it is impossible to employ the frictional electric machine as the exploding agent without great risk of failure, even though the wires, laid upon or imbedded in earth, are separated as widely as possible, as they must unavoidably extend in proximity to each other to a distance from their points of union with the machine, which, if the latter be highly charged, may prove sufficient to determine the development of induced "exploding" currents in the wires leading to mines not intended to be fired. If the wires lead to submarine mines or torpedoes, and are therefore submerged, the unintentional explosion of mines becomes much more certain, and the frictional machine is consequently inapplicable to submarine operations in all instances where mines are arranged in separate circuits. The dynamo-electric machines share this serious defect to some extent; still, with proper experience in their use, they are not altogether inapplicable to such services as above specified. If Siemen's dynamo-electric machine be highly charged by very rapid revolutions of the armature, the inductive action of the charge will be similar in power to that exerted by the charge of the frictional machine, but, by revolving the armatures slowly, it is possible to charge the machine sufficiently to fire a mine or a small group with certainty, while the inductive action of the charge sent into the wire will not influence neighbouring wires to an extent sufficient to cause the explosion of mines connected with them.

The subject of the application of electricity to the explosion of submarine mines for purposes of defence and attack received some attention from the Russians during the Crimean war, and was practically developed in its most simple form in 1859, in the hands of the Austrian Government, when a system of submarine mines, to be fired through the agency of electricity by operators on shore, was applied by Baron von Ebner to the defence of Venice, which, however, never came into practical operation. The subject of the utilisation of electricity for purposes of defence did not, however, receive serious consideration in England or other countries until some years afterwards, when the great importance of submarine mines as engines of war was demonstrated by the number of ships destroyed and injured during the war in America. Twenty-five vessels belonging to the Federal navy were destroyed and nine others injured by the explosion of torpedoes, while the Confederates lost three vessels by accidentally coming into collision with their own torpedoes, and one which was attacked by means of a torpedo and destroyed by the Federals.

Soon after the commencement of that war the attention of the English Government was called to the importance of practical inquiry into the value of subma ine obstructions, both passive and active, as auxiliary agents of defence, and a committee was appointed at the suggestion of Colonel Jervois, C.B., R.E., to report on the use which might be made of floating or sunken obstructions and of submarine mines, in the defence of channels, harbours, and rivers. The labours of this committee have recently terminated, and they were enabled, by the aid of systematic investigations conducted for them at Woolwich during the last four years by one of their members, Mr. Abel, and of practical experiments carried on chiefly at Chatham under the direction of another of their body, Colonel A. à'C. Fisher, C.B., R.E., to elaborate the subject of the application of electricity to submarine mines and torpedoes, to such an extent that a solid foundation of information and instruction is now available for those who may at any time have to be entrusted with the actual arrangement and employment of these important means of defence. Continental Governments have also devoted much attention to this subject, and especially the Austrian Government, for whom Baron von Ebner devised an ingenious and elaborate system of electric torpedo defence, exhibited in detail at the Paris Exhibition of 1867, which received application during the recent war, though its efficiency was not actually put to the test except in the way of experiment.

The application of electricity to the explosion of torpedoes was very limited during the American war; but arrangements for the extensive employment of that agent as the exploding power were far advanced in the hands of both the Federals and Confederates at the close of that war. It appears that only in two instances of the entire number of vessels destroyed and injured was the explosion of the torpedoes effected by electric arrangements, the others having all been exploded by mechanical agency.

The explosion of submerged charges of gunpowder by mechanical contrivances, either of a self-acting nature or to be set into action at desired periods, was accomplished as far back as 1583, during the siege of Antwerp by the Duke of Parma. The English employed self-acting torpedoes against the French ships off Rochelle in 1628, and from that period to 1854 devices of more or less ingenious and practicable cha-

racter have been proposed from time to time, and even applied to some small extent in different countries, for the explosion of torpedoes either by clockwork, at fixed periods, or by coming into collision with a ship. The Russians were the first to apply self-acting mechanical torpedoes with any prospect of success, and there is little doubt that had the machines which were applied to the defence of the Baltic been of larger size (they only contained 8 or 9 lbs. of gunpowder), their presence would have proved very disastrous to some of the English ships which came into collision with and exploded them. Various mechanical devices for effecting the explosion of torpedoes by their collision with a ship were employed by the Americans during the recent war, a few of which proved very effective. But although, in point of simplicity and cost, a system of defence by means of mechanical torpedoes possesses decided advantages over any extensive arrangements for exploding submarine mines by electric agency, their employment is attended by such considerable risk of accident to those at whose hands they receive application that, under many circumstances which are likely to occur, they become almost as great a source of danger to friend as to foe. Thus the operations of lowering and mooring torpedoes, the explosion of which depends upon the application of a blow, thrust, or pull to some portion of the machine, which is so placed and arranged as to be in a favourable position for the application of mechanical action by a passing ship, are attended with very great danger to those employed, unless some means are adopted for rendering the exploding mechanism inactive until after the torpedo has been placed in position. But the employment of a safeguard of this kind involves a considerable amount of uncertainty as to the torpedo being rendered active, by its removal after the operation of mooring is completed, because this very removal is frequently a dangerous operation. Again, when once the mechanical torpedoes have been placed in position and rendered active, they are as dangerous to friendly ships as to the enemy; consequently their employment for the defence of a particular tract of water completely closes it until the torpedoes have been exploded or removed, and their removal obviously constitutes one of the most dangerous services upon which men can be employed. Several instances have recently occurred in America of the destruction of ships in waters defended during the war by mechanical torpedoes, of which it was believed that the subsequent removal had been completely accomplished. Some improvements have recently been made in mechanical and chemical appliances of a self-acting nature for torpedoes by the employment of which the mooring arrangements can be completed with perfect safety, and the torpedoes afterwards rendered active, by the performance of a simple and safe operation when it is desired to close the defended water. But the complete exclusion of friendly vessels, and the difficulties attending the raising of the torpedoes when no longer required, still constitute formidable objections against the use of mechanical torpedoes, excepting in the case of tracts of water which are not ordinarily navigated, but the passage of which in times of war might be attempted by vessels of light draft.

The most important advantages secured by the application of electricity as the exploding agent of submarine mines and torpedoes are as follows:—They may be placed in position with absolute safety to the operators; they may be rendered active or passive at any moment from the shore; the waters which they are employed to defend are therefore never closed to friendly vessels until immediately before the approach of an enemy; they can be fixed at any depth beneath the surface (while mechanical torpedoes must be situated directly or nearly in the path of a passing ship), a circumstance which very considerably simplifies the arrangements for their application in tidal waters; lastly, electric torpedoes may, when no longer required, be removed with as much safety as attended their application.

There are two distinct systems of applying electricity to the explosion of torpedoes. The most simple is that in which the explosion of a torpedo is made dependent upon the completion of the electric circuit by operators stationed at one or more posts of observation on shore. The particular mode of arrangement and the operation to be adopted depend in great measure upon the nature of the locality to be defended by torpedoes. If this be a river or channel, the plan of arranging and exploding torpedoes is comparatively simple, but will serve sufficiently to illustrate the general nature of this system of applying torpedoes. The mines are arranged across the river or channel in rows or lines, converging towards a station on shore, to which the conducting wires are led which are to connect each torpedo with the exploding instrument. The operator at this station has it in his power, therefore, to explode any one of the torpedoes at will, by completion of the circuit through the particular cable and the earth. Some other position on shore is selected as a second station, which commands points of view intersecting the lines of torpedoes. The operators at the two stations are placed in telegraphic communication with each other, and when a ship is observed by the operator at the second station to approach the direction of any one of the torpedoes, he will signal to the man who looks along this line of torpedoes, and the latter will complete circuit as soon as the vessel appears over the particular torpedo specified. Should the vessel alter her course in approaching the torpedoes, the operator at the observing station will inform the man at the firing station, who will alter his arrangements accordingly. Or, the man at the observing station, when he perceives a vessel to approach in a line with any of the torpedoes, places the cable of that torpedo in electric connection with the operator at the other station, and the latter will complete the circuit through the earth to the torpedo as soon as he sees that the vessel is over the first line of torpedoes. Other more or less elaborate modifications of these modes of observing and exploding have been proposed; they all depend for efficiency upon the experience, harmonious action, and constant vigilance of the operators at the exploding and observing stations. They are, moreover, entirely useless at night, and in any but clear weather. They are therefore not to be compared, in general efficiency, with self-acting electric torpedoes, which are either exploded by their collision with a ship, whereby electric circuit is completed within them, or by the vessel striking a circuit-closing arrangement moored near the surface of the water, whereupon either the torpedo, moored at some depth beneath, is instantly exploded, or a signal is furnished at the station on shore, which indicates to an operator the particular torpedo to be exploded. The object to be attained in these circuit-closing apparatus, which are so moored as to be within range of a passing ship, is to oppose in the path of a vessel a contrivance which will not be affected by the motion of the water, but which will complete electric circuit between the conducting cable and the fuse, if

struck in some particular part, or thrown into a particular position, by the advancing ship. Numerous ingenious contrivances have been proposed for this purpose and experimented with, but in only two or three instances have satisfactory results been attained, the conditions essential to success being numerous, and their combined fulfilment not easy of attainment. Simplicity of mechanism and a combination of sufficient, but not excessive, delicacy of action, with permanence during long immersion, are among the most important objects to be aimed at in the construction of these circuit-closing or signalling machines, or self-acting torpedoes, which, if efficient, must contribute most importantly to the success of any arrangements for defence of a water by electric torpedoes.

It has been shown that magneto-electric instruments cannot be relied upon for submarine operations, on account of the perfect insulation of the conducting wires, joints, &c., required to insure success with machines of that class. On the other hand, frictional machines and also dynamo-electric machines leave little to be desired as regards power to effect even the simultaneous ignition of numerous submarine mines, through cables in the insulation of which, from long-continued use, some defects exist. Th se instruments, therefore, are available as most efficient instruments when any extensive submarine operations have to be accomplished; but the frictional machines cannot be used as the exploding agents in connection with any system of defence by torpedoes which depends for its efficiency upon the explosion at the proper moment of only the particular torpedo over which a vessel passes, while all surrounding torpedoes still remain intact; because, for the reason which has been given, the explosion of the proper torpedo will almost invariably be attended by the accidental explosion of others which it is not desired to bring into operation. The same objection applies, at any rate to some extent, to the dynamo-electric machines. These two classes of instruments are therefore only susceptible of certain special applications in connection with submarine mines. There is, moreover, another general objection to the use of any source of electricity, the action of which is entirely dependent upon an operation to be performed at the instant that an electric discharge is required. This consists in the fact that, although the torpedoes may be self-acting, their efficiency is still dependent upon the vigilance and presence of mind of an operator on shore.

The only sources of electricity which thoroughly fulfil the conditions essential to its application with perfect confidence in connection with self-acting torpedoes, are constant voltaic batteries. By substitution of the Abel fuse for the old platinum-wire fuse, it has become possible to use batteries which were previously inapplicable to the explosion of mines, because, even when employed in considerable numbers, the quantity of electricity furnished by them is not sufficient to effect the ignition of platinum wire. Thus, a number of elements of a Daniell's battery, or a sand battery, quite incapable of heating a platinum wire to redness, fires an Abel fuse with perfect certainty. The heat developed in the latter by the passage of a current from such a battery amply suffices to raise to its igniting point the readily explosive priming mixture which serves as the conductor in the fuse. Moreover, the resistance presented by the fuse is so considerable in comparison with that offered by the longest cables which are likely to be used in actual practice, that a current from a battery which possesses tension sufficient to overcome the resistance of the fuse will explode the latter with as much certainty, through cables of great length, as when it is close to the battery. A number of cells of a Bunsen's battery, sufficient to ignite a piece of platinum wire several inches in length, when close to the battery, the current of which possesses also sufficient tension to ignite an Abel fuse, will be incapable of rendering a very short piece of thin platinum wire even moderately warm, if four or five hundred yards of ordinary conducting wire be introduced into circuit; but its power of exploding an Abel fuse will not have become at all affected. It is evident from this illustration that the necessity for greatly adding to battery power, when mines are to be exploded through considerable lengths of wires, which exist with the use of the wire fuses, is obviated by employing the new fuse; and thus one great objection to voltaic batteries, as exploding agents in mining operations, is set aside. Again, the sand batteries, or Daniell batteries, which are used for telegraphic purposes, and which when once charged, continue, with very little attention, in constant and good working action for several months, may now be substituted for the batteries (*e. g.*, Grove's or Bunsen's) which it was formerly necessary to employ in order to attain sufficient quantity of current, and which only continue in good action for a few hours. Sand batteries have been repeatedly employed at Woolwich for the explosion of fuses, after having been in action four or five months, with the occasional addition of a little water to compensate for evaporation.

It will be seen, from the foregoing, that constant voltaic batteries combine more thoroughly the essential qualifications of efficient exploding agents, in connection with any system of submarine defence, than all other sources of electricity at present known. They are simple of construction, inexpensive, require but little skill or labor in their production and repair, and very little attention to keep them in constant good working order for long periods. Their action is quite independent of any operation to be performed on shore at the last moment; it is only necessary to place the cables leading to the torpedoes in connection with the battery when it is desired to close a defended water—the circuit-closing portion of the torpedo, upon being struck by a ship at any time, will then cause the instantaneous explosion of the charge. The defence by torpedoes thus becomes as effective by night as by day; moreover, the efficiency of the constant batteries is not more prejudicially affected by the existence of defects in the insulation of the cables than that of the frictional electric machines; and they may be used without incurring any risk of the unintentional explosion of torpedoes by induced currents.

Simple and powerful forms of batteries are readily extemporized, and there is no more portable, simple, or economical description of exploding instrument than the ordinary volta-pile, for the construction and employment of which it is only necessary to provide a piece of hard timber, some zinc and copper sheet, an old blanket, and some vinegar and common salt. A pile, composed of 120 elements, the plates being 2¾ inches in diameter, is very portable, and suffices to explode a mine in single circuit, or three or four arranged in branch circuit. It will remain in good action for at least twenty-four hours, and is readily and expeditiously cleaned and re-charged. This apparatus has become a favorite exploding instrument with sailors, being easily constructed and charged anywhere, and very handy for boat operations (in connection with the employment

of torpedoes as an arm of attack), in which service more delicate instruments speedily lose in efficiency. Larger piles constructed on precisely the same plan are now being used in some ships of war for the simultaneous discharge of guns, and a very small form of pile, with water only as the exciting agent, is the most convenient instrument for testing the fuses and cables of torpedoes after they are in position. It is a matter of great importance that a positive knowledge of the efficiency of a torpedo and its conducting wire should be obtained from time to time by electric tests, and there is now no difficulty in including the fuses themselves in the test. Signals may, in fact, be readily passed from one firing station to another through the fuse in a submerged torpedo, which is arranged to be fired at will from the shore.

It does not come within the scope of this discourse to enter upon a discussion of numerous important subjects connected with the actual use of electric torpedoes, or of the considerations involved in the question as to how these formidable agents of defence may be most efficiently applied, in addition to, or in the absence of, artillery defences. The object of the discourse will have been attained if it has been satisfactorily demonstrated that electrical science is destined to contribute most invaluably to the efficiency of a country's defences.

ON THE

ESTIMATION OF COPPER IN ORES,

BY CERTAIN METHODS FOR WHICH A PREMIUM HAS BEEN AWARDED.

(Concluded from Am. Repr., June, 1869, page 299.)

Estimation of Copper in the Mansfeld Ores, according to the Method proposed by M. C. Luckow, at Deutz.

For a few years, the gentleman just named has applied to the quantitative estimation of copper present in salts, alloys, and ores, a new method, based upon the precipitation of the metal in metallic state, from solutions containing either free sulphuric or nitric acids, by means of a galvanic current.

It is a great advantage of this method, that, while the copper is precipitated, it is simultaneously separated from metals with which it is often found alloyed, some of which, such as tin and antimony, are separated by treatment with nitric acid in an insoluble form, while others, like silver, can easily be removed in the form of chloride. It is, at the same time, another advantage that the state in which the copper is obtained, admits of its being accurately weighed and estimated, while a great number of operations, which require much time and various apparatus, is, at the same time, got rid of.

Although, already some four years ago, M. Luckow had discovered a method of electro-metallic analysis from fluids containing free sulphuric acid, his researches on the same subject, in the case of free nitric acid, belong to a later period. These researches brought very unexpectedly to light the curious fact, that even a weak galvanic current had the power to completely precipitate copper in a pure metallic state, from solutions which did not contain more than 0·1 grm. of anhydrous nitric acid to the c.c. (nitric acid of 1·2 sp. gr. contains 0·32 grm. of anhydrous nitric acid to the c.c.), while it was, at the same time, found that the action was more regular, and less dependent upon the power of the current than when free sulphuric acid was present. The following more commonly occurring metals are *not* precipitated by galvanic action from acid solutions:—Zinc, iron, nickel, cobalt, chromium, the metals of the earths, and alkalies. There are precipitated—

(*a*). In the shape of peroxides, at the positive electrode: completely, lead and manganese; incompletely, silver. When the solution contains traces of manganese, it becomes, in consequence of the formation of a salt of peroxide of manganese, or permanganic acid, deeply violet coloured. This very sensitive reaction for manganese also takes place when small quantities of chlorine are present. The presence in the fluid of oxalic, lactic, and tartaric acids, and other readily oxidisable organic substances, and such protoxides as are readily peroxidised—for instance, protoxide of iron—retard the formation of peroxides, as well as the setting-in of the reaction of manganese.

(*b*). Precipitated at the negative electrode in metallic state, are mercury, silver, copper, and bismuth. When mercury is present in the solution simultaneously with copper, the former metal is separated before the latter, in the fluid metallic state. As soon, however, as the precipitation of copper commences, there is, when mercury is also present, formed an amalgam of the two metals. Silver is precipitated almost simultaneously with copper; bismuth only begins to be precipitated after the greater portion of the copper has been already separated. A complete separation of silver only ensues when some such substance as tartaric, or any other similar acid is simultaneously present in the solution. The separation of the three last-named metals, by means of galvanic action, is, therefore, unsuccessful; but, fortunately, we have plenty of other means to accomplish this end completely.

(*c*). Metallic arsenic is only precipitated slowly; and long after the complete separation of copper, is the former metal separated from arsenic acid, if it should happen to be present. The same remark applies to antimony, since it is well known that small quantities of antimonic acid are soluble in nitric acid.

The operations, according to Luckow's plan, are—I. Roasting of the ore; II. Solution of the roasted product; III. Precipitation of the copper; IV. Weighing of the copper.

I. *Roasting of the Ore.*

Care should be taken to obtain a finely-ground, average sample of the ore. M. Luckow then weighs off, in previously accurately counterpoised small porcelain capsules, quantities of from 1 to 3 grms.; these quantities are then placed on the inverted lid of an iron crucible, on the inner surface of which the powdered ore is heated, over the flame of a Bunsen gas-burner. The powder may be carefully stirred up with a platinum wire, to promote the access of air during the roasting, and the ignition of bituminous matter and sulphur may be ended in about seven minutes. Ores which do not contain bitumen at all need not be roasted.

It has been already stated that, especially as regards poor copper ores (and those of the Mansfeld district are generally so), the quantities to be weighed off for assay should not vary according to a presumed percentage of copper. One gramme is too small a quantity; 2 grms. are now taken, and, instead of roasting the ore on the lid of an iron crucible, small porcelain crucibles are applied for that purpose.

II. *Solution of the Roasted Product.*

According to M. Luckow's plan, the iron lid is suffered to cool, the roasted powder placed on a piece of glazed

paper, and any powder adhering to the lid is removed by means of a camel's-hair brush, on to the paper. The powder is next transferred to small beaker glasses, and some 2 or 3 c.c. of nitric acid, of 1·2 specific gravity, are added, along with about 10 to 15 drops of concentrated sulphuric acid. The beakers are then placed on a sand-bath, and moderately heated, at first; but when the contents have nearly become dry, the heat is increased, so as to evaporate and expel all sulphuric acid. The beakers should be covered with perforated watch glasses. This operation requires from about three-quarters to one hour. The addition of sulphuric acid is made in order to increase the oxidizing action of the nitric acid, and also to convert any lime which may happen to be present in the ore into a difficultly soluble salt. It is very useful, also, to add some 10 or 20 drops of hydrochloric acid to the mixture of the two acids just alluded to, since the rapidity of the evaporation is thereby increased, and the occasional spirting about of the fluid is lessened.

The process just described is modified, of course, first by the use of porcelain capsules, the contents of which are easily transferred to beakers with flat bottoms, and not higher than about 2 inches in all. It is better, also, to use a sulphuric acid, prepared of equal bulks of concentrated acid and water, and to measure off 4 c.c. for each assay; while for each assay, moreover, 6 c.c. of nitric acid, and about 25 drops of hydrochloric acid are taken. Instead of covering the beaker with a perforated watch glass, a funnel is used, as represented in Fig. 1; with this arrangement, the sulphuric acid evaporates far more readily, and loss by spirting is prevented. The beaker is heated on a well-arranged sand-bath.

III. *Precipitation of the Copper.*

As soon as the beaker-glass, after removal from the sand-bath, has become quite cool, the funnel which has been used as a cover is washed on both sides, inner and outer, with nitric acid of 1·2 sp. gr., diluted with six times its bulk of pure water; the sides of the beaker are next likewise washed, and the latter filled to about half its height with the same acid. A few drops of a concentrated solution of tartaric acid are added (which acid, by the bye, is best kept in solution in open vessels, only slightly covered with a piece of paper); this having been done, the wire spiral, represented in Fig. 2, is carefully placed into the beaker-glass. This spiral consists of a piece of platinum wire, about 1-12th of an inch thick, and 7½ inches long, while two-thirds of its length is so wound that the straight end of the wire projects as if it were the axis of the centre of the spiral. The convolutions of the spiral are so large that they touch the sides of the beaker, while the straight portion just touches the centre of the bottom of the vessel.

When the heating has been carefully attended to, the acid fluid added to the contents of the beaker, after evaporation to dryness, will generally be quite clear; if it happens to be turbid, 1 or 2 c.c. of a concentrated solution of nitrate of baryta may be added, and the thorough mixing of this saline solution with the acid contents of the beaker promoted, by gently moving up and down the platinum spiral just alluded to, and allowing the fluid to rest for a few minutes after. The copper present in the mass left at the bottom of the beaker gradually dissolves; and it is not actually requisite to wait for applying the galvanic current until it is all dissolved.

The next point is to place in the beaker the platinum foil, represented at Fig. 3, of which the dimensions are—length, 2½ inches; width 1¼ inches. The lower end of this platinum foil should be left about 1-16th of an inch apart from the convolutions of the spiral. When the beaker is only half filled with liquid, the platinum foil is immersed in the same for more than three-fourths of its height. The wire fastened to the said foil is fixed, by means of a screw *a*, to the arm *ab* of the stand, represented at Fig. 4; the other screw, *b*, serves to fasten

Fig. 2

Fig. 1

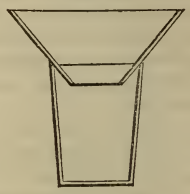
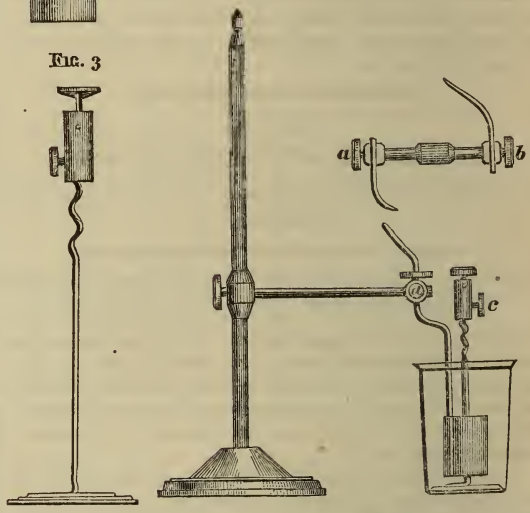


Fig. 4

Fig. 3



a copper wire, proceeding from the zinc plate of the galvanic battery. When the small screw clamp *c* (Fig. 4) has been fastened to the platinum wire placed in the beaker, another wire is fastened in the top opening of the clamp just referred to, and this wire connected with the copper-plate of the battery, and the galvanic circuit thus closed. In a few moments after this has been done, the platinum foil, bent in the shape of the cylinder and placed inside the beaker, as before described, will be observed to become covered with a coating of metallic copper, while from the platinum wire spiral bubbles of gas escape, which facilitate, to some extent, the solution of the oxide of copper in the dilute acid.

In order to ascertain whether the whole quantity of the copper has been precipitated, some more dilute nitric acid is added to the fluid in the beaker-glass. If, in ten minutes after this, no more metallic copper is separated on the clean portion of the platinum foil, the operation is finished.

It is to be here observed that continued practice has proved that the addition of a concentrated solution of nitrate of baryta acts injuriously on the process, in so far as the metallic copper, which becomes separated,

gets mixed with some insoluble sulphate of baryta, which increases the weight of the substance to be weighed. The cylinder made of platinum foil, should not be at a greater distance from the platinum spiral wire than about 1-16th of an inch.

The time occupied by the complete precipitation of the metal varies according to the force of the galvanic current. It varies in duration from three to even eight hours. In order to make this point certain, all test assays are left for eight hours consecutively, in contact with the galvanic current, experience having proved that, after that lapse of time, even with a weak current, the precipitation was so complete that all chemical reagents, even the most delicate, for detecting copper, failed to discover even the most minute trace of that metal.

IV. *Weighing the Copper.*

According to M. Luckow's plan, the platinum cylinder to which the copper adheres, and the platinum wire spiral are disconnected from the galvanic apparatus, the platinum cylinder carefully removed from the beaker and immediately plunged into a beaker filled with fresh cold water, and rinsed therein; next washed with alcohol, by means of a washing bottle, and then dried in a drying apparatus, and weighed after cooling. Since the platinum cylinder had been very accurately weighed *before* the experiment, its increase in weight will, of course, be that of the copper obtained.

The process here described has been somewhat modified and greatly improved upon at Eisleben, where it is in constant use, by means of a series of galvanic elements. It is, in the first place, found better not to disconnect the galvanic current while yet the copper is in contact with acid, so that, instead thereof, the acid fluid in the beaker is replaced by running in a stream of water, and suffering the same to run over the sides of the beaker, and to be received into a proper vessel to hold it. In this manner all the acid is displaced, without risk of any very small quantity of copper becoming acted upon by the acid during the brief period lapsing between the disconnecting of the galvanic current and the removal from the beaker of the platinum cylinder and spiral wire. These parts, on being removed, are carefully washed, first with boiling water, next with alcohol, and then dried, at a temperature of about the boiling point of wat r. The cylinder is then weighed, and, after that, the copper coating is removed therefrom, by means of nitric acid; next washed in water, dried, and again weighed.

There are in use at Eisleben nine galvanic batteries (lead and zinc elements); these yield eighteen assays ready for weighing in twenty-four hours. It would be easy for the person there employed to work with twelve batteries, each of three elements. The results obtained are highly satisfactory. The following observations may be made in reference to this method:—

(*a*). The quantity of ore taken for trial is 2 grammes, and is found sufficient, while it consumes less acid.

(*b*). The evaporation of the acid is carried on to complete dryness on the sand-bath. Spirting of the fluid is easily prevented; when the copper has been precipitated properly it will show its peculiar colour on the surface, and the good success of the operation may be judged from the fact, also, that no saline matter adheres to the platinum; the complete absence of which saline matter has been found to be evidence of complete removal of the copper from the fluid.

The process just described is especially applicable and useful for rather poor ores, such as do not contain above 7 or 8 per cent of copper. Each assay, from beginning to end, takes ten hours for complete analysis; but it is evident that the longer portion of this period is such as does not give active employment to the assayer. The expense of working this process, after the apparatus have been once purchased, is very small indeed. The process may be applied to analyse rather rich ores, and also of alloys of copper, with some slight modifications, which require attention, especially, also, if silver should happen to be present.

ON A NEW METHOD OF

ESTIMATING THE REDUCED PHOSPHATES OF LIME, MAGNESIA, IRON, AND ALUMINA,

IN SUPERPHOSPHATES OR MANURES.

BY J. A. CHESSHIRE.

Attention having been called this season to what is termed the going back, or the reduction, of the soluble phosphates into insoluble phosphates, in superphosphates, as an analytical chemist at a manure works in the midland counties (Bradburn & Co., Wednesfield, near Wolverhampton), I have been required to estimate the reduced phosphates so formed. The plan now in use—viz., boiling with citric acid—is, I have found, not to be relied upon, as I have partially dissolved ground coprolite in this acid. The way that I am in the habit of doing is this:

Take about 1½ grammes of superphosphate, extract the soluble part with cold water, and, afterwards, with boiling water; wash the insoluble residue on the filter into a beaker, boil for about half an hour with oxalate of ammonia and about two drops of oxalic acid, so as to have a slight acid reaction; this I do in order to keep the phosphate of magnesia in solution. Then filter; the filtrate contains the phosphates of lime and magnesia, and, perhaps, a little phosphate of iron and alumina. To the filtrate add tartaric acid, ammonia, and the magnesia mixture, weigh the precipitate, and estimate the phosphoric acid as $Ca_3(PO_4)_2$; the insoluble residue on the filter, from the reduced lime and magnesia, wash into a beaker, boil for about one hour with sulphide of ammonium and a few drops of ammonia, filter, &c.; to the filtrate add the magnesia mixture, and calculate the results in the same manner as the reduced phosphates of lime and magnesia.

I may add, that the reduced phosphates so formed are quite equal, in money value, to the soluble phosphates.

ON THE

SOURCE OF FREE HYDROCHLORIC ACID IN THE GASTRIC JUICE.*

BY PROFESSOR E. N. HORSFORD, CAMBRIDGE, U.S.A.

Following up the researches of Prout, C. Smidt, Lassaigne, Tiedemann and Gmelin, Berzelius, Blondlot, Claude Bernard, Schwann, and others, the author endeavours to determine how free hydrochloric acid can be secreted from the blood, which is an alkaline fluid. He assumes that in healthy digestion, as a consequence of increased flow of blood to the gastric mucous membrane, and of the normal elasticity of the walls of the

* Abstract of a paper read before the Royal Society, April 15th, 1869

capillaries, there exists in the membrane a condition which is the equivalent of engorgement. Under the pressure which attends this condition, the corpuscles in contact with the walls of the capillaries would discharge a portion of their acid contents, which, with the adjacent plasma, would pass through the walls of the capillaries. This mixture would contain acid phosphates and chlorides.

By pressure and osmosis, a portion of this fluid will pass through the walls of the gastric tubes; and, to determine whether the fluid that goes through contains free hydrochloric acid, the author employed an acid phosphate of lime, of specific gravity 1·117, of a constitution of $3(CaOPO_5)+2PO_5$, with an amount of phosphate of peroxide of iron present as one to twenty-eight of the acid phosphate of lime. The various other solutions employed were the ordinary laboratory reagents.

On adding ammonia in small quantities to the solution of acid phosphate, with alternate agitation, it required several repetitions before the peroxide with its phosphoric acid became a permanent precipitate, and still several more before the precipitate of phosphate of lime became permanent.

The experiments were made with parchment-paper, prepared from German and Swedish filter-paper, as well as with goldbeaters' skin (animal membrane).

He employed acid phosphate of the formula above, with (each by itself) chloride of sodium, chloride of ammonium, chloride of potassium, chloride of calcium, and chloride of magnesium.

The author also experimented with acetate of potassa and acid phosphate of lime.

With all these there was obtained the same kind of evidence of increased acidity on one side, and of increased alkalinity on the other, to wit, the powder thrown down from the mixture of acid phosphate and chloride. What successive additions of ammonia had been required to effect had been accomplished by dialysis.

The same effect took place from a mixture of acid phosphate of soda and chloride of calcium.

It follows from the above, if these experiments fairly represent the case, and from the known composition of the blood, its condition in the walls of the stomach, and the structure of the gastric tubules, that free or uncombined hydrochloric acid must find its way into the bottoms of the gastric tubules, and thence into the cavity of the stomach.

The secretion of hydrochloric acid is mixed with acid phosphates and alkaline chlorides.

The author therefore states that, whatever other peculiarities the blood corpuscles may possess, they have the requisites for furnishing acid phosphates in solution under pressure, such as must attend engorgement of the capillaries in the walls of the stomach; that, in all probability, as the acid fluid enters the gastric tubules, they are surrounded by a mixture of hydrochloric acid, acid salts, neutral salts, and albumenoid bodies. Dialysis must be repeated, and a stronger acid solution pass into these sacs. The sacs, swelling by endosmosis, and corroded by the acid, must at length burst, and the liquid contents, together with the disintegrated and partially digested membrane of the sacs, pass out into the stomach, to constitute the gastric juice; the free hydrochloric acid, acid phosphates and chlorides, and the albumenoid bodies and disintegrated tissue (*the pepsine?*) to act in the liquefaction of food.

ON A CERTAIN

EXCRETION OF CARBONIC ACID BY LIVING PLANTS.*

BY J. BROUGHTON, B.SC., F.C.S.,

CHEMIST TO THE CINCHONA PLANTATIONS OF THE MADRAS GOVERNMENT.

While the author was engaged in some experimental determinations of the changes that take place in the composition of the Cinchona barks after being taken from the tree, he noticed a somewhat singular circumstance, which induced him to institute a series of experiments, by which he discovered that the various parts of living plants excrete carbonic acid, not only in their normal condition, but after they have been deprived for days together of all access of oxygen. The experiments were mostly made on cut portions of the plants, but experiments were also made for control on plants as they actually grow. The deprivation of oxygen was effected sometimes by Sprengel's air pump, sometimes by substituting for air an atmosphere of hydrogen or nitrogen, while comparative experiments were made on plants supplied with air that had been freed from carbonic acid. The main conclusions to which he was led are those enunciated by the author:—

1st. That nearly all parts of growing plants evolve carbonic acid in considerable quantities, quite independently of direct oxidation.

2nd. That this evolution is connected with the life of the plant.

3rd. That it is due to two causes, namely, to previous oxidation, resulting after a lapse of time in the production of carbonic acid, and to the separation of carbonic acid from the proximate principles of the plant while undergoing the chemical changes incident to plant-growth.

THE

ELLERSHAUSEN PROCESS OF REFINING IRON.

The recent invention of Mr. Ellershausen, which is now regularly in use in Pittsburg, Pa., and is being rapidly introduced all over the country, has greatly advanced the solution of the problem of cheap iron.

The process consists in the conversion of crude cast-iron, as it runs from the smelting furnace, into wrought-iron, by the simple admixture of pulverised iron ore. It is carried out at the works of Messrs. Shoenberger, at Pittsburg, in the following manner:—On the casting floor of the smelting furnace, a cast-iron turn-table, about 18 feet diameter, is revolved on rollers by a small steam-engine. Upon the outside edge of the table stand a row of cast-iron partitions, forming boxes, say, 20 inches wide and 10 inches high, open at the top. Just above the circle of boxes stands a stationary, wide-mouthed spout, terminating in the tap-hole of the furnace. When the furnace is tapped the liquid iron runs down this spout, and falls out of it in a thin stream into the boxes as they slowly revolve under it, depositing in each a film of iron say one-eighth of an inch thick. But before the fall of melted iron reaches the boxes it is intercepted, or rather crossed, at right angles, by a thin fall of pulverised iron ore, which also runs out of a wide spout from a reservoir above. These two streams or falls are of about equal volume, say one-quarter of an inch deep and 20 inches wide. A workman, with a bar

* Abstract of a paper read before the Royal Society, April 28th, 1869.

in the tap-hole, regulates the stream of iron, and the iron spout from which the liquid metal falls into the boxes is removable; other spouts, previously coated with loam and dried, being attached to a common revolving frame, so as to be ready for use when the loam covering of the first becomes cracked or removed.

The thin layers of iron and ore soon chill and solidify, so that by taking away the outer partition of the boxes (which form the rim of the turn-table) they may be removed in cakes of the size of the boxes and weighing about 200 pounds each. Four of these cakes or blooms are put into a reverberatory puddling or heating furnace, and raised to a bright yellow heat. They will not melt at this heat, but become softened so as to be easily broken up with a bar. The four blooms are formed in the furnace by the "rabble" of the workmen, as in ordinary puddling operations, into eight balls. The balls are brought out one after another, squeezed in the ordinary "squeezers" to expel the cinder and superfluous ore, and then rolled into wrought-iron bars, which are now ready for market, or for further reduction into smaller finished forms.

The chemistry of the operation is as follows:—The crude cast-iron contains, say, 5 per cent of carbon, and 2 per cent of silicon, and more or less sulphur, phosphorus, and other impurities. In the Bessemer process the oxygen of the air, blown into the liquid iron, combines with this carbon and these other impurities, and not only removes them but leaves the pure iron in a liquid state, from which it can be cast into homogeneous masses of any size. In the puddling process, the oxygen of the air and of the ore or other "fettling" put into the furnace with the iron combines with and eliminates the impurities, which are afterwards squeezed out of the pasty mass by the squeezers and rolls. This process is long and comparatively expensive, because the mixture of oxygen or oxygen-bearing substances is not made intimate with the iron except by long stirring, which is not only skilful but exhausting work.

In the Ellershausen process the oxygen of the ore or oxide of iron (manganesic oxide is preferred) combines with the carbon and impurities, eliminating them as in the puddling process, and the iron of the ore increases the product. The chemical combination of the ore and the liquid crude iron appears to take place partly at the time of their contact when falling and lying upon the turn-table, and partly where the re-heating occurs in the furnace. It seems impossible that a reaction which is so violent in the Bessemer process, and so prolonged in puddling, should take place so quickly and quietly in the new process, but the fact that the cakes of iron and ore do not melt by subsequent heating, as cast-iron would, proves that its nature is changed by the first contact of the ore. The removal of sulphur and of phosphorus also seems more thorough than in the other processes. Analyses at different stages of the operation will throw more light on this question.

The remarkable feature of the Ellershausen process is that absolutely no skill is required to carry it out. The proportion of ore mixed is intended to be about 30 per cent, but if too much is added, it is readily squeezed out with the slag, and seems to do no harm. The subsequent heating occupies about half an hour. "Puddle-bar," the product obtained from the first rolling of the product of the puddling furnace, is never marketable or finished iron. It is usually very ragged and unsound, and requires subsequent piling, re-heating, and re-rolling, to expel the impurities, and to give it soundness and solidity. The new process appears to produce merchantable iron at the first rolling, and at Pittsburg, from a very inferior pig-iron made of one-half sulphurous Canada ores, and one-quarter Lake Superior and one-quarter Iron Mountain ores.

The thoroughness and rapidity of the purification by this process evidently depend on the intimacy of the mixture of iron and ore. This intimate mixture is also the essence of the Bessemer process. In fact, to Mr. Bessemer's original apprehension of this idea of intimate mechanical mixture the greatest modern improvements in the iron manufacture are due.

The Ellershausen process is said to decrease the cost of wrought-iron from 10 dollars to 20 or 30 dollars per ton, according to the materials used and the form of the product required. That it is a success is amply proved by regular working at Pittsburg and many experiments elsewhere.—*American Artisan.*

DR. LETHEBY

ON THE

METHODS OF WATER-ANALYSIS AND ON SEWAGE CONTAMINATION.

A few weeks ago Dr. Letheby read a very important paper to the Metropolitan Association of Medical Officers of Health, entitled "On the Methods of Estimating Nitrogenous Matters in Potable Waters, and on the Value of the Expression 'Previous Sewage Contamination,' as used by the Registrar-General in his Monthly Reports of the Metropolitan Waters." The discussion which followed it was very animated, and was so long that an adjournment for a fortnight was found necessary. In this interesting paper, Dr. Letheby attacked with great warmth the methods of analysis employed by Dr. Frankland, the deductions which the latter chemist thinks himself justified in making from the results of his analysis, and in particular the well-known calculation of "previous sewage contamination" from the nitrogen found as nitrates, nitrites, and ammonia in the water. He described the methods in which he himself places reliance—methods which need not be recapitulated here because they are familiar to almost all chemists—and in contrast with them recited a formidable list of the difficulties and errors to which, he asserted, Frankland and Armstrong's methods were liable. This part of the subject, important though it be to chemists, we do not propose to discuss in any detail at the present time, reserving it, if need be, for a separate consideration hereafter. The combustion process, by which Dr. Frankland estimates the organic carbon and nitrogen of a water, is, to judge from the trial experiments, very greatly more accurate than any that has hitherto been suggested for the determination of organic matter. Both the absolute and percentage errors observed in the trial experiments were, indeed, marvellously small, considering the extraordinary difficulties to be encountered. Dr. Letheby appears to rely mainly upon the permanganate test, and calculates the amount of organic matter in the water by multiplying the oxygen-indication by eight. This calculation is founded on a comparison between the indications of the test and those of the old incineration method; but as the latter has long been known to be worthless, and as Dr. Letheby himself has abandoned its use, it is difficult to see how the calculation can give even an approximation to correctness. Every one of our readers is, moreover, aware that the oxidising power of the permanganate varies extremely in different cases; that of nine kinds of organic matter

examined by Frankland and Armstrong, one—viz., oxalic acid—was completely oxidised by it, even in six hours; that urea, hippuric acid, and creatin were scarcely oxidised at all, while the mineral, sodic nitrite, was oxidised instantaneously.

These considerations are, however, somewhat irrelevant upon the present occasion, for Dr. Letheby does not seriously impugn the accuracy of the method by which Frankland and Armstrong effected the determination of the nitrogen present as nitrates and nitrites, and agrees with the latter chemists in employing the Nessler test for the determination of ammonia. It is from these compounds that the previous sewage contamination is calculated, and it is to this calculation that the criticism of Dr. Letheby is mainly directed. The ammonia present in potable waters is generally a small quantity, and we may therefore assume, for the purpose of the present discussion, that the previous sewage contamination is entirely deduced from the nitrates and nitrites of the water. Dr. Letheby does, indeed, impugn the accuracy of the correction made by Dr. Frankland for the nitrogen introduced by rain; but this makes little real difference, for even if the estimate of Lawes, Gilbert, and Way be adopted, and the river be assumed to contain the whole quantity of combined nitrogen found by those chemists in the rain of Rothamstead, without a grain having been removed by vegetation, the deduction would only be equal to 985 parts in 100,000 of previous sewage contamination, instead of 320, a difference equal to less than one-fifth of the amount frequently attributed to some of the London waters in the Registrar-General's returns.

Divested in this manner of collateral issues, the arguments of Dr. Letheby may be reduced to a few simple propositions. He maintains, in the first place, that the nitrates and nitrites of potable waters are not due solely to the oxidation of animal matters, but are frequently derived from other sources, and that therefore it is fallacious to use them as a measure of previous animal contamination. Under any circumstances, moreover, they could not be an accurate measure, because the process of vegetation is constantly removing them from waters exposed to its action, and it consequently happens that waters known to have received sewage contamination are sometimes found to contain scarcely any oxidised nitrogen, while others which, it is alleged, cannot have received any such contaminations contain much. A good illustration of this apparent anomaly was quoted by Dr. Letheby. In the months of July, August, and September, 1868, the water supplied by the Kent Company, and derived by them from deep chalk wells, was described by the Registrar-General as exhibiting a previous sewage contamination of 3660, 3660, and 3530 parts in 100,000; while that of the East London Company, derived from the sewage-contaminated Lea, was returned for the same months as 0, 0, and 20.

It is furthermore urged by Dr. Letheby that it is unfair to describe by a name calculated to produce disgust and alarm, a contamination which, whatever its source, has been oxidised and rendered innocuous in the water. Sewage diluted with twenty parts of water is, he asserts, entirely destroyed in the course of a run of ten or twelve miles down a river, and it is therefore impossible for mischief to arise from the drinking of such water.

To these various hostile criticisms, cogent replies have been produced. Dr. Frankland argues upon the first point, that, after the most diligent search, he has failed to discover the slightest evidence of the formation of nitrates from vegetable matters. Whenever nitrates are found in England or abroad, they can be traced generally with the utmost ease, to animal sources, and whenever such sources are absent, nitrates are absent too, although considerable quantities of combined nitrogen may be present. It would be a wonderful thing if the water of the chalk wells did not frequently contain nitrates, considering that it is derived by percolation from the sewage and manure-stained soil above. In the case of the chalk water supplied to London, the probability of direct sewage contamination is peculiarly great, for the great fault in the chalk, from which the Kent Company on one side of the river and the South Essex Company on the other, derives so large a supply of water, passes directly under the foulest part of the Thames. Dr. Frankland admits most fully that the calculation of sewage contamination is only an approximate one. In proportion as the nitrates have been removed by vegetation in streams or reservoirs, the calculation will, of course, be too low. All that he pretends to do is to show the *minimum* contamination which can have occurred, and he points out that injustice cannot be done to the water companies because he can never exaggerate, and very frequently understates, the previous pollution of their water. It is of course true that animal contaminations of all kinds have to be reckoned in terms of London sewage. The phrase to which Dr. Letheby so much objects is by no means intended to signify that the contamination has in all cases been the actual sewage of towns. All such contaminations are objectionable in the highest degree, and there can surely be no harm in referring them to so suitable a standard as the one selected. It is employed for the comparison of different animal contaminations, just as physiologists compare different kinds of food by their *starch-equivalent*, without intending to assert that all kinds of food consist of starch; and it must not be forgotten that as applied to the greater part of the water supplied to London and other towns, the phrase simply states an indubitable fact.

Finally, we may observe that the self-purifying power of running water is doubted by no one, least of all by Dr. Frankland, who founds his calculation of previous sewage upon his study of it. But the absolute statement made by Dr. Letheby in regard to it—the sharp line which he draws to fix the complete purification of the water—is liable to considerable doubt. Dr. Frankland, Sir Benjamin Brodie, and many other chemists believe the process to be much less uniform and rapid than it has generally been supposed to be, and that, under certain circumstances, it is even almost inoperative; but if their views were entirely erroneous, it would be none the less incumbent upon Dr. Letheby to prove his statement. We know as an absolute fact that tons upon tons of human excrement are thrown into the waters of the Thames and Lea before we drink them, and we have a right to look for absolute demonstration of the complete destruction of all this filth; and not only of the filth itself—of the lifeless organic matter;—we must also be convinced that it is impossible, at all times and under all circumstances, for living matter—the low forms of life and their germs with which the processes of disease and putrefaction appear to be so closely connected—to retain their vitality under the conditions assigned by Dr. Letheby, before we can be content to accept his statement, or can learn to look with indifference upon previous sewage contamination.

It is, we trust, no discourtesy to say that the chemical methods heretofore employed appear inadequate for such a proof. The noxious matters of a water are probably beyond the reach of the test tube and the balance. They belong, in all probability, to that inscrutable class in

which the virus of small-pox and cattle plague must be reckoned. That they would resist the oxidising action of the water longer than mere chemical compounds, can hardly be doubted, and, indeed, it has yet to be demonstrated that the dissolved oxygen of the water has any greater destroying effect upon them than it has upon the fishes which inhabit the same streams.

ALKALI WORKS.

We inserted last week a letter from an alkali manufacturer, urging that if alkali makers comply with the "Alkali Act," no farmers or other persons ought to be allowed to complain. This is a bold position. He forgets that the Alkali Act controls one gas only. We suppose he is an Englishman, and yet he wishes to take from his countrymen the right of grumbling—the right of petition and complaint. We doubt if Parliament, with all its power in this respect, can interfere. Besides, the Alkali Act does not demand perfection from the manufacturers. It was established to diminish an evil in such a manner that it should not hurt the manufacturers; but it did not attempt to decide whether the 5 per cent of muriatic acid allowed to escape could under any circumstances injure any person. We know that coal smoke will damage plants, because of the sulphurous acid in it, small as it is; we conclude, therefore, with certainty, that any addition of acid will injure them yet more; and 5 per cent of escape from an alkali works may probably injure in cases where the total amount given out is great and the fields readily struck.

Admitting that an alkali maker is very far from infringing the Alkali Act, is he always equally innocent of doing mischief by gases not mentioned in it? Weight for weight sulphuric acid is in reality more dangerous to plants than muriatic acid. It is extremely heavy, and a little does much evil, because it does not readily disperse. Now, do the alkali makers and sulphuric acid makers keep all their fumes to themselves? We have no information as to the alkali makers, but we have heard of a man, not an alkali maker, who lets go 20 per cent of his sulphuric acid. We enquire of the Inspector of Alkali Works, and what does he say?—He is very sorry, but he has no right to interfere, or even to enter the works. If he were asked his opinion of such a work—supposing it were also an alkali work—he would say that, so far as he is concerned, he can find no official fault; and this would be a work complying with the Alkali Act, and yet worse than farmers even imagine.

Some people may think we are talking loosely, and that, as it is the interest of a manufacturer to keep his acid, they may venture to assert such prodigality is impossible. This kind of argument is very common; so far as chemical works are concerned, however, it does not hold good: people do act against their own interests. Do we not know in the abstract that all evil is against the true interest of man, but it does not therefore cease?

We hope we have said enough to show that the Alkali Act is not sufficient to protect the farmers even from alkali works; and what shall we say of copper works, sending out their 100 per cent of sulphurous and sulphuric acid in clouds that dull the sky for miles; of chlorine, of nitrous gases, of sulphuretted hydrogen, and of fluorine compounds? The Alkali Act regards only one of the noxious gases; and the question may be put—Shall it be extended to more? In some places its influence can be but small, because so many other gases interfere. But, even when they do not interfere, is it not true that an escape of muriatic acid may come, and, in a few hours, destroy the labour of months? Is this just in the alkali makers? Of course, all are not to be blamed for this, nor are all believed to allow any sulphuric acid to escape, but we say it because, as a rule, the farmer has ground for complaint as well as the alkali maker. We do not, however, entirely take the farmer's side; by no means: we know of men who could not stay at a farm when the alkali works were given up; and the greediness of human nature constrains us to doubt if the manufacturers are quite justly treated by the farmers.

"An Interested Person" asks if a scientific legal court ought not to be constituted. Trials for nuisances are generally very unsatisfactory. There is no authorised person to put down the daring assertions made by some men. We have heard one say that sulphuretted hydrogen did no harm to human beings, and the judge could not contradict. Not long ago, we heard of a witness who said that the gases complained of were a mixture of sulphurous acid, chlorine, and sulphuretted hydrogen! Now, no judges are even expected to know that these gases cannot exist together, and, with one or two exceptions, barristers do not know. If a chemist happen to be present, he may get a pertinent question put, but if not very determined, he may find a difficulty, and many would rather let the case go to wreck than be put to the discomfort of asserting their knowledge amidst the unpleasant badgering of a public court. The greater number of the questions arising at a trial would be settled by men who had very simple notions of justice if only the facts were well known.

Would a scientific court do the work better? It was purposed that the Inspector should have most of the gases under his view, and should be allowed to settle questions which involved claims such as are brought to a County Court. We do not pretend to decide, and should be unwilling to lay claim in favour of scientific men to the prejudice of such an important body as men of law. We believe that it would be better for both parties if the facts of the case were probed more fully by a chemical mind. Scientific men cannot expect to adjudicate so clearly in vexed questions as the legal profession, which has struggled since civilisation began to put in order the varied activities of the human race, which yearly invents new crimes and makes room for new virtues. Perhaps "An Interested Person" may, on further consideration, think his view of this question not quite adequate.

ON A METHOD OF MAKING

RAPID DETERMINATIONS OF FREE OXYGEN.

BY P. HART.

The apparatus required consists, in addition to an ordinary pneumatic trough, of two tubes each half-inch diameter and 16 inches long, closed at one end. One of the tubes is graduated into 50ths of a cubic inch, and the other is coated internally with phosphorus. This is effected by dropping into the tube a few pieces of phosphorus; it is then to be closed by a sound cork, and the phosphorus (melted by immersing the tube in hot water) may be spread in a thin coating over the interior by turning it round as it cools. On cooling, the cork is to be withdrawn, the tube filled with water, and a piece

of india-rubber tube tied securely over the mouth. This completes the apparatus.

Modus Operandi.—Both tubes are filled with water and allowed to remain in the trough, a portion of the air to be examined is passed into the measuring tube, which is now allowed to remain for five minutes in the trough to allow it to attain the same temperature as the water. It is lifted until the water is at the same level within and without, and may then be closed by the finger, and withdrawn from the trough. The volume is easily noted. This done, it is connected by the india-rubber joint with the phosphorus tube, into which the air is allowed to flow. The whole may now be placed for half an hour in the trough, when the gas may be poured back into the measuring tube, the level once more taken, and the volume read off in the same way as before. The loss is oxygen.

a. Measuring tube.
b. India-rubber junction.
c. Phosphorus tube.

No claim is made for strict scientific accuracy in connection with this apparatus; its sole merit consists in its offering an easy and rapid means of approximately determining the free oxygen in an atmosphere. In the working of sulphuric acid chambers it has been found extremely valuable, and possibly may be found so for other technical enquiries.

REMARKS ON THE

ESTIMATION OF COPPER IN ORES.

BY FREDERICK FIELD, F.R.SS. L. AND E.

There is a detailed account in the Chemical News (Nos. 489 and 491; *Am. Repr., June,* 1869) of certain methods for the estimation of copper in ores, for which a premium has been awarded. The paper also contains some valuable observations by Dr. Steinbeck on the volumetric determination of copper by means of cyanide of potassium, known generally in England as Parkes's method. Dr. Steinbeck gives us the results of his experiments, which prove that, in order to estimate the metal correctly, care must be taken to avoid great excess of ammonia, or its salts, as these exercise a very disturbing influence. The Dr. has also paid considerable attention to the influence which other metals exert when in combination with the copper, and finds that lead does not interfere in any way with the valuation of the former. He recommends the thorough washing away of the salts of zinc from the precipitated copper, previous to its solution in nitric acid, as the presence of that metal would greatly interfere in the estimation of the copper.

The writer is able most fully to confirm the above statements, from the lengthened experience he has had in South America in the estimation of copper in ores, slags, etc., many thousands of assays having been performed by Parkes's method; but there are other metals, not mentioned in Dr. Steinbeck's report, which frequently occur associated with copper, and would also be precipitated upon the zinc, together with that metal. Arsenic is, perhaps, the one most generally found; and, from many careful experiments, it has been satisfactorily proved that it exerts no influence whatever upon the correctness of the method. The same may be said of both tin and antimony.

It can be easily imagined that the metals whose oxides are soluble in ammonia would interfere with the amount of alkaline cyanide necessary to remove the colour from an ammoniacal solution of a known weight of pure copper, seeing that a portion of the cyanogen is devoted to the other metals, as well as to the copper itself. This is, of course, the case with silver, zinc, nickel, and cobalt; the two first metals forming double cupro-cyanides of great beauty and interest; and it can also be well understood that *more* cyanide is required in these instances than with copper *per se*.

But the writer has shown (Chemical News, vol. i., p. 26, *Eng. Ed.*) that, in the case of manganese, the result is entirely different, the solution of the two metals requiring *less* cyanide than copper would for its decolourisation. For instance, 10 grains of electrotype copper were brought into solution with 20 grains of sulphate of manganese, and a known weight of ammonia and chloride of ammonium added. The cyanide of potassium contained in 85 divisions of the burette was found sufficient* to decolourise the liquid; while 100 divisions were requisite for ten grains of copper without manganese, treated under precisely similar circumstances.

The writer would be very glad if some one of the numerous readers of the Chemical News would explain this fact, which he confesses appears to him somewhat difficult.

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.†

BY EDWARD C. C. STANFORD, F.C.S.

Our great object is to consider, first, how to carry away from our houses the excreta of our large population; and secondly, how to treat it so as to recover for our use its full fertilising value. The peculiar character of the material to be dealt with renders some vehicle necessary for its transport.

This vehicle may be either solid, liquid, or gaseous; and the secondary proposition depends so entirely upon the vehicle employed for the first, that I intend briefly to review these three several means of conveyance in their chemical aspect. To avoid complication in speaking of either, I shall assume the general adoption of solid vehicles, the cheapest being earth, of liquids water, and of gases air; I shall speak of the three different methods as water, earth, and air carriage, taking water first, as being now most common.

I wish to premise, however, that I regard both the above propositions as essential and necessary; and take as my text Mr. F. O. Ward's celebrated formula—"The rainfall to the river, and the sewage to the soil,"—no system of sewerage is worthy our consideration which does not give back to the soil that which in our food we have taken from it; and I consider the mere ridding ourselves of a valuable fertiliser, simply on account of difficulty in dealing with it, quite beneath the enlightened spirit of our age.

For convenience of calculation, I take the population of Glasgow at 500,000, and the value of the excreta at 8s. 4d. per head per annum, or £208,333. This is the value given by Professor Way and Mr. Lawes (the highest authorities on this subject), in the third report of

* On the addition of Liebig's cyanide of potassium to an ammoniacal solution of the oxides of manganese and copper, a certain portion of the former is precipitated. It might be imagined that this precipitate dragged a portion of the copper with it out of solution; this is, however, not the case; the precipitates in many instances having been carefully examined for that metal.

† Read before the Glasgow Sewage Association, March 30th, 1869.

the Sewage Commission, and it is now generally adopted by all chemists, each person being reckoned as contributing the value of 12½ lbs. of ammonia per annum.

The total bulk of excreta, making allowance for loss, is estimated at 10 cubic feet per head per annum, and its weight 630 lbs., making an annual total of 5,000,000 cubic feet, weighing 140,625 tons; or, per day, 13,698 cubic feet, or 385 tons.

This, then, is what Glasgow has to remove. The value is 10d. per cubic foot, or 29s. 6d. per ton, and equal (Professor Way) to 16,666 tons of Peruvian guano annually. Of this amount the solids form 1-10th, and the liquids 9-10ths; or 1 cubic foot per head per annum solid, and 9 cubic feet of liquid. The solid and liquid excreta have a relative chemical value of 1 to 6, or 1s. 2d. per head for the former, and 7s. 2d. per head for the latter. The total is thus divided:—

	Tons.	s. d.	£
Annual value of solid excreta..	14,062 at	41 5 ..	29,161
" " liquid " ..	126,563 "	28 3 ..	179,172
			£208,333
The value of the daily removals is	385 "	29 6 . .	£569

Let us see how this is proposed to be removed, and what is to be gained in the process.

WATER CARRIAGE.

Taking the amount of water used per head at 5 cubic feet daily, and the rainfall the same, we have the 10 cubic feet diluted with 3,650 of water, and the annual material to be removed increased from 500,000,000 cubic feet to 1,825,000,000 cubic feet, or 140,625 tons increased to 50,920,401 tons; in other words, we require daily to pump away 140,000 tons of sewage to remove 385 tons of excreta, of which only 38½ tons is solid matter. No wonder we are called upon for lavish expenditure to carry off such a quantity as this, for even if no pumping were required, the cost for sewers must be enormous. And then does it carry it away?—and does it utilise it? Suppose an elaborate system of intercepting sewers to convey our sewage to some point several miles down the river; would that meet the evil? Let the experience of London answer this. The metropolitan sewage works are the greatest effort of this kind, and, from the difficulties overcome, are a perfect triumph of our engineering skill, reflecting the highest honour on Mr. Bazalgette; but they cost the princely sum of £4,250,000, or £180,262 per annum, the cost to be paid off in forty years by rating, at the end of which period the Thames will probably be closed as a port by their deposit, the sewer gases will have proved themselves the most deadly of enemies, and London will stand on a substratum of soil loaded with sewage from infiltration and leakage.

To show that these are not improbable speculations, I append an extract from an able article in the *Pall Mall Gazette* of February 26, 1868, entitled "The Sanitary Dead-Lock":—

"It has now been decided that although Parliament has conferred the right of drainage into the sea and public rivers, this right can only be exercised subject to the condition that no other nuisance is thereby created. 'The notion of collecting all the sewage of a large town,' says Vice-Chancellor Wood, in the case of Blackburn, 'and pouring it into a river without the slightest attempt to clear it of any of its grossest materials, is simply monstrous.' And, again, in the Attorney-General *v.* Birmingham Town Council, the court went as far as to declare that it would not balance the convenience of a town against the legal rights of an individual complainant—the latter must be respected. . . . . The case of the metropolis differs from that of the provincial towns, but has occasioned a similar sanitary dead-lock. The main-drainage system discharges the refuse of London into the Thames at Barking and Crossness, comparatively out of the way of population. Although there is, therefore, no sanitary objection to these works, except as regards the towns below London, such as Barking, North Woolwich, Greenwich, Erith, &c., a serious difficulty of another kind has arisen. The mass of matter daily washed down by the sewers of London is so great that, during the few years that have elapsed since the opening of the new sewers, an enormous concentrated deposit of mud, street sweepings, and sewerage refuse has accumulated in the bed of the river at Barking and Crossness, and now obstructs the navigation of the river. Last November Mr. Cave stated in the House of Commons that a ship had already stranded on one of the banks thus formed. A chart of the bed of the river at Barking, which has recently been prepared, shows that in the very centre of the channel the soundings have diminished at low water from 21 to 10 feet. . . . Whatever may be the legal aspect of the question, it is quite evident that the navigation of the Thames cannot be allowed to be obstructed even for the sake of draining the metropolis, and that legislative interference will be required if the existing Acts are at all doubtful on this point. Indeed, the whole subject demands the careful consideration of Parliament, in order to release the municipal authorities throughout England from the embarrassing position in which they are now placed. Some way must be discovered of draining our towns at a less sacrifice than is involved in the pollution of streams and blocking up of navigable rivers."

And as to the sewer gases, it appears, according to the evidence collected by the sewage commission, quite impossible to get rid of them; one of the engineers examined making this terribly suggestive answer:—"I am afraid we must let out the stink in the middle of the streets."

Now stink is not the word, for sewer gases are gases of decomposition, and carry malaria, pestilence, and death with them. Dr. Fergus has related one of many instances in which a number of houses at Leith, previously healthy, have been affected at once with gastric (or typhoid) fever, when connected with the sewers; and showing the constant infiltration of sewage into the soil, and thence into wells; he has also pointed out cases of gastric fever where the long unsuspected cause was the drinking of the water so contaminated.

Mr. Bazalgette states, that to ventilate the London sewers by air would cost £460,000 in plant, and £201,480 annually for fuel alone, exclusive of labour and other expenses; he also states that to flush them with water would cost £383,250 annually, even if the waterworks could supply the quantity, which is out of the question. The water-closet system is also open to great objection—the best constructed closet is seldom perfectly free from odour; the back rush of deadly gases up the sewers when a high tide covers them, or a strong gale blows into their outlets at low tide, is of enormous force, and will rise through any closet, however well trapped.

Water is a mere carrier, and no disinfectant; its cost, also, from the great quantity required, is very considerable. Mr. Smith has stated the cost here at £40,000 per annum, and, no doubt, if general, £50,000 at least

[English Edition, Vol. XIX., No. 495, page 254.]

would be required to provide the water and keep up the closets.

The whole system of sewerage by water-carriage is recklessly extravagant; it carries the solid and liquid excreta down to our neighbours to rot at their doors, and it leaves us a legacy of deadly gases to remind us that our endeavour to cheat nature has signally failed. As applied to even ridding ourselves of the nuisance, it is the finest effort of "the circumlocution office," and the best illustration of "how not to do it," in our generation.

Engineers have employed an elephant to do the work of a mouse, and the burly brute has trodden down and has laid waste the country.

Then, as to its utilisation; here the system almost entirely breaks down. Notwithstanding numerous attempts, no portable manure ever has been, or ever will be, made out of sewage. The chemical value of average sewage, if it could be extracted, is 1d. per ton, taken at 4 grains ammonia to the gallon; this value is deduced from 93 analyses of Rugby sewage by Professor Way, and now generally admitted. One thousand tons are equal to 12 cwts. Peruvian guano.

Much has been said here about the solid matter deposited from sewage by standing; let it be clearly understood that it is almost valueless. At Birmingham it accumulates in large quantity, and cannot be sold at 6d. per ton. The reason of this is obvious; almost the entire manurial constituents are soluble in water; and no wonder all companies looking amongst the deposit for their dividends have failed to find them. They are exactly in the position of a ferret, watching patiently one end of a rat hole while the rat has escaped by the other.

The report of the sewage commission gives abundant evidence that even sewage irrigation only pays in certain favourable circumstances. This report is full of information, and represents an enormous amount of labour by its learned authors. They have worked hard to pick out the grain of wheat from the sack of chaff; bnt we must all admit that it would have saved them much trouble if we had never allowed the admixture.

Irrigation, the only method of utilising sewage, puts an amount of money value on the ground out of all proportion to the return obtained by the ratepayers. There appears no doubt that the farmer will not give ½d. per ton for it, delivered free of expense. Where gravitation and open carriers can be employed without pumping, its application is remunerative; but in no case is anything like the full money value obtained to the ratepayer. The cost of transport, where the chemical value of a product is only 1d. per ton, is far the more important item.

According to Professor Way's estimate, Glasgow would requre 10,000 acres, constantly in use, at 5,000 tons sewage per acre per annum, and it would really require 15,000 acres, as one-third must be under root crop.

Now, in a damp climate like ours, what land would take this extra amount of water? and what farmer would ever dream of top-dressing his grass with manure equal to 3 tons of Peruvian guano per acre, if he had to pay the full market value for the manure? Moreover, what could be done with the grass where, as in our case, it would be impossible to make it into hay?

This system of sewage by water carriage is, however, now so general, that any means of modifying its evils may be worth our notice.

The sewer traps shall all be provided with sieves of charcoal; and I propose to avoid the unsuspected dangers of the sewer gases rising in our present water-closets, to employ a double sieve of wire gauze, containing charcoal, which will slide in just under the seat, and completely close the opening, and which, by a little mechanism, can be made to slide back automatically. Or to enclose the charcoal in a small box with wire gauze sides, and simply place it in the closet. I employ, by preference, seaweed charcoal, the use of which I propose also for the filtration of town sewage, before it is allowed to pass into rivers. It is singularly allied to animal charcoal, which it excels in its porosity, its high oxidizing power, and in the ease with which it admits the rapid passage of thick liquids. The thickest sewage passes through perfectly odourless and colourless. It entirely removes the organic matter from ordinary sewage, and can be used for a considerable length of time, without change. To gain its full power, the sewage should be run into large tanks, which can be used alternately; it is here allowed to deposit for 24 hours. The filtration should be upwards, through a stratum of char, and, when the deposit rises to the char, the whole should be mixed together, and made into manure; the char mixed with the sludge would render it more easy of transport. I do not intend to imply that the char removes the manurial value of the sewage to any great extent, but it renders it innocuous.

(To be continued.)

REPORTS OF SOCIETIES.

ROYAL INSTITUTION OF GREAT BRITAIN.

Annual Meeting, Saturday, May 1st, 1869.

Sir Henry Holland, Bart., M.D., D.C.L., F.R.S., *President, in the Chair.*

The Annual Report of the Committee of Visitors for the year 1868 was read and adopted.

The books and pamphlets presented in 1868 amounted to 116 volumes, making, with those purchased by the managers, a total of 220 volumes added to the library in the year, exclusive of periodicals.

Fifty new Members were elected in 1867.

Sixty lectures and twenty evening discourses were delivered during the year 1868.

Thanks were voted to the President, Treasurer, and Secretary, to the Committees of Managers and Visitors, and to the Professors, for their services to the Institution during the past year.

The following gentlemen were unanimously elected as officers for the ensuing year:—

President—Sir Henry Holland, Bart., M.D., D.C.L., F.R.S.

Treasurer—William Spottiswoode, Esq., M.A., F.R.S.

Secretary—Henry Bence Jones, M.A., M.D., F.R.S.

Managers—George Berkley, Esq., C.E.; William Bowman, Esq., F.R.C.S., F.R.S.; Charles Brooke, Esq., M.A., F.R.S.; George Busk, Esq., F.R.C.S., F.R.S.; Adm. Sir Henry John Codrington, K.C.B.; Warren De la Rue, Esq., Ph.D., F.R.S.; John Peter Gassiot, Esq., F.R.S.; John Hall Gladstone, Esq., Ph.D., F.R.S.; Wm. Robert Grove, Esq., M.A., Q.C., F.R.S.; George Macilwain, Esq.; The Duke of Northumberland; William Frederick Pollock, Esq., M.A.; Robert P. Roupell, Esq., M.A., Q.C.; The Hon. John William Strutt; Colonel Philip James Yorke, F.R.S.

Visitors—Andrew Whyte Barclay, M.D.; Charles Beevor, Esq., F.R.C.S.; John Charles Burgoyne, Esq.; Sir C. Wentworth Dilke, Bart.; Alfred Gutteres Henriques, Esq.; Sir Thomas Henry; Thomas Hyde Hills, Esq.; Thomas Lee, Esq.; William Longman, Esq.; Edward Henry Mos-

crop, Esq.; Rev. Cyril W. Page, M.A.; Edmund Pepys, Esq.; The Lord Josceline W. Percy; Arthur Giles Puller, Esq., M.A., F.S.A.; Robert Ballard Woodd, Esq., F.S.A., F.R.B.S.

General Monthly Meeting, Monday, May 3rd, 1869.

Sir Henry Holland, Bart., M.D., D.C.L., F.R.S., *President, in the Chair.*

The following Vice-Presidents were nominated for the ensuing year:—The Duke of Northumberland; William Spottiswoode, Esq., F.R.S., the Treasurer; J. P. Gassiot, Esq.; and George Busk, Esq.

Lieut.-Colonel Archibald Campbell Campbell; Sir William Dickason Clay, Bart.; William Wilbraham Ford, Esq.; John Benjamin Marsden, Esq; and Herbert Schloss, Esq., were elected Members of the Royal Institution.

John Tyndall, Esq., LL.D., F.R.S., was re-elected as Professor of Natural Philosophy.

The Managers announced that, in conformity with the deed of endowment, they had appointed Michael Foster, M.D, F.L.S., Fullerian Professor of Physiology.

FRENCH ACADEMY OF SCIENCES.

Monday, April 26th, 1869.

A communication was read from the Rev. Father Secchi, S.J., "*On the Spectroscopic Phenomena of the Sun's Spots*" recently observed by him; he finds that the spectra of these spots present great analogy with those of the stars known as Arcturus and Aldébaran. He also mentions that the different spots he had the opportunity to examine on the sun's disc exhibit differences identical to those which characterise the spectroscopical appearances of the stars.

During the proceedings of this meeting, at which no papers or communications on chemistry were sent in, several papers were read, and a long discussion ensued, on the aurora-borealis alluded to in our last report of the meetings of this scientific body; it appears that the phenomenon has been observed even in the southern parts of France, while perturbations of magnetic instruments have been reported from Leghorn as well as from Greenwich.

A discussion, wherein M. Sainte-Claire Déville took a prominent part, on the changes produced in the weather, barometric pressure, and temperature subsequent to the observation of the aurora-borealis, led to no definite result as far as the fixing of causes and effects in this matter is concerned.

M. L. Hugo, from Versailles, addressed a note "*On the Construction of a Synoptic Pyrhelioscope*," by means of which instrument it would be possible to see all the solar protuberances at the same time; the instrument is intended to be a spectroscope to which, by means of suitable clockwork, an angular motion may be imparted. The note and description were handed over to a committee to report thereon.

Two papers relating to electricity were read, but as both belong rather to the domain of higher mathematical physics, they are unfit and too abstruse for abstraction in our pages.

Monday, May 3rd, 1869.

A considerable portion of the time occupied by the meeting was devoted, as is too often the case with the *savants* who are seated there in the *fauteuils d'honneur*, to personalities.

General Morin presented a report from the committee appointed to enquire into the alleged insalubrity attending the use of cast-iron stoves. The committee, of which the General was a member, has instituted a series of experiments on this subject at the Conservatoire des Arts et Métiers; the results arrived at are (1) all heating apparatus made of metal, and all stoves made of cast-iron, give off, while in use, a large quantity of carbonic oxide; (2) the quantity of that gas given off from stoves made of plate-iron, more or less thick boiler plate, is often insignificantly small; (3) the carbonic acid contained in the air is readily converted into carbonic oxide, by coming into contact with thoroughly red-hot cast-iron of the stoves made of that material; (4) the oxide of carbon thus generated may, especially in confined localities, become very injurious to health.

The committee recommend to line the cast-iron stoves inside with fire-bricks, and to envelope them outside with a casing of sheet-iron, so arranged as to leave space for free circulation of air in communication with a well-drawing chimney.

On behalf of Messrs. Mille and Durand-Claye, Ingénieurs des Ponts et Chausseés, M. Dumas reports on the work undertaken by these gentlemen, viz., the useful application of the sewage water from Paris, taken at the bridge near Asnières. Every cubic metre of this water contains 1 kilo. of solid matter, and 37 grammes to the kilo. are nitrogenous matter. The engineers above named treat this water with sulphate of alumina, whereby all the phosphoric acid, two-thirds of the nitrogenous matter, and rather more than one-half of the potassa salts present in the water are completely precipitated, and perfectly clear, inodorous water is left, which may either serve for irrigation of arable soil or meadows, or may be run off into rivers, without injury to the purity of the water of the same.

According to M. Morren, and contrary to the opinion given by M. Sarrasin, hydrogen and nitrogen gases become phosphorescent under the influence of an electric spark or galvanic current, provided the gases be perfectly pure, and under very reduced pressure. This statement gave rise to some discussion, since many of the *savants* present doubted the suitability of the means adopted by M. Morren to insure the purity of the gases at so low a pressure.

M. Berthelot read "*A Memoir on the Chemical Equilibrium between Carbon, Hydrogen, and Oxygen*," which we shall, probably, notice more fully at a future day.

Several papers were read about subjects relating to the geology of France, the meteorology and climate of the Isthmus of Suez, which, with some botanical papers, brought this meeting, as far as the public is concerned, to a close, at half-past five o'clock, p.m.

Monday, May 10th, 1869.

Some very interesting papers were read, but, inasmuch as some of these do not belong to chemistry, or sciences intimately connected therewith, we confine our report to what chiefly interests our readers, and, in the first place, we notice some communications by the Rev. Father Secchi, S.J., "*On the Spectrum of the Sun's Spots.*" The learned astronomer, having found that the spectrum of red-coloured stars contains lines indicating the existence of carburetted hydrogen, has searched the spectrum of the sun's spots and faculæ, in order to detect therein, if possible, similar lines; and he has been successful in finding the same. We regret that we can only briefly notice this very important communication, since, without diagrams and woodcuts, it is not possible to enter fully into this subject.

M. Kerikuff has addressed a brief note to the Academy on the subject of the scintillation of the stars. He states that, so far back as the year 1861, he had given an explanation of that phenomenon, identical with that lately set forth by M. Respighi. The note is handed over to a committee, for enquiry and report thereupon.

On behalf of M. Le Roux, M. Edmond Becquerel read a communication "*On the Phenomena of Electric Light and Phosphorescence in the midst of (au sein de) Rarefied Gases.*" According to the author's statement, it is not at all necessary that an electric current should be made to pass through a gas: electricity by induction is sufficient to exhibit the phenomena. When a toothed wheel which is electrified is rapidly set in motion in close proximity to a tube containing any well-suited rarefied gas, the tube becomes illuminated and the gas phosphorescent.

[English Edition, Vol. XIX., No. 492, pages 223, 224; No. 493, page 235; No. 494, page 247.]

M. des Cloizeaux read a paper on the crystalline form, the optical properties, and chemical composition of gadolinite, a rather rare mineral, some specimens of which exhibit double refraction, while others again do not. The mineral has been found hitherto only in Norway, near Hitteroe, and in Sweden, near Ytterby. The name of the mineral is derived from M. Gadolin, a Russian chemist, who first discovered this substance, and proved it to contain yttria and glucina, as well as the oxides of cerium, of lanthanium, and silica. M. des Cloizeaux states that the monorefracting crystals ought to be referred to the epidote. The percentage composition of the gadolinite from Ytterby is, according to Dr. Berlin's analysis, quoted by the author—Silica, 25·62; oxide of yttrium, 50·00; oxide of cerium, 7·90; protoxide of iron, 14·44; lime, 30·00; magnesia, 0·54; alumina, 0·48; potassa, 0·19; soda, 0·18. Total, 100 65.

Our readers, on referring to our report of the meeting held on the 3rd of May, will find that M. Berthelot read a memoir on the chemical equilibrium between carbon, hydrogen, and oxygen. At this meeting the said gentleman read the concluding portion of his work. The chief fact observed is, that the decomposition of carbonic acid by the electric spark does not come to any fixed end—in other words, does not proceed beyond a certain limit—because the oxide of carbon and oxygen resulting from the decomposition of the carbonic acid have a tendency to become combined again and re-constitute carbonic acid.

M. Sainte-Claire Deville made a statement about his meteorological experiments and observations, from which he concludes that the changes of temperature are subject to periodical variations, returning regularly after 90, 30, and 10 days, due to and caused by the passage of our earth through different portions of the space of the universe. The same gentleman and M. Silbermann had a long discussion on the subject of the cause of the aurora borealis, which led, however, to no result of any importance to the general scientific public.

On behalf of M. Margueritte, M. Sainte-Claire Deville read a note setting forth the objections they have to make against the theory of M. Dubrunfaut concerning the supersaturation of sugar solutions in alcohol. The author says that Dubrunfaut has not proved by any experiment that when crystallisable sugar is dissolved in water, and alcohol added, any change should take place in the sugar itself. It is, therefore, evident that nothing else happens than the return to the solid state of a substance previously dissolved, and the crystallisation of which was impeded either by the presence of water, or some other unknown cause.

CHEMICAL SOCIETY.

May 6th, 1869.

Dr. A. W. Williamson, F.R.S., *President, in the Chair.*

The minutes of the previous meeting were read and confirmed.

The President then read a petition, to be presented to both houses of Parliament, of which the following is a draft:—

"*The Humble Petition of the President and Council of the Chemical Society,*

"Sheweth,—That the Chemical Society was incorporated by Royal Charter for the general advancement of Chemical Science as intimately connected with the prosperity of the manufactures of the United Kingdom. That in the opinion of your petitioners, the future intellectual position of Great Britain, and her success as a manufacturing nation, are in a great measure dependent on the scientific education of her people. That the Society of Arts, in their report on technical education, assert that the only effectual systematic training for technical pursuits consists of two steps—first, a thorough study of several branches of science, including chemistry; secondly, professional pupillage. That at the present time the study of natural science is altogether neglected in a large number of our secondary schools, while in the remainder it occupies only a subordinate position, both in respect of the time allotted to it and of the credit to be gained by proficiency in it. That the neglect of the study of natural science is in great part due to the influence exercised by the endowed schools, which, by their number, their antiquity, and the large funds at their disposal, determine the course of studies in other schools, their own course of education representing the requirements of a past rather than of the present age. That the necessity for inquiry into the teaching in endowed grammar schools has already been recognised by the appointment by Her Majesty of three commissions to report on this class of schools in England and Scotland. That the Schools' Inquiry Commission have, in their report, pointed out various practicable means for the promotion and extension of the study of physical science in schools. Your petitioners, therefore, humbly pray your honourable house to enact such laws as may procure for Chemistry, and other branches of natural science, as important a position among endowed school studies as that now occupied by Latin and Greek.—And your petitioners will, &c."

The following certificates were read:—

For the first time—Wm. G. Valentin, assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gillham Hewlett, Surgeon, Bombay Army, Health Officer, City of Bombay, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B. A. Oxford, Sympsham Rectory, Weston-super-Mare.

For the third time—E. Meusel, University College; A. W. Reinold, Merton College, Oxford; J. M. Muir, Shortland, Thames Gold Field, New Zealand.

The last-named gentlemen were then balloted for and duly elected.

Mr. J. Lowthian Bell then delivered a lecture "*On the Chemistry of the Blast Furnace,*" of which the following is a condensed abstract:—

There are few chemical processes requiring for their proper operation greater nicety, or where perfect success is contained within narrower limits than the smelting of iron.

The ends sought to be accomplished in the blast furnace are the deoxidation of the peroxide of iron, which is the usual form of combination in which the metal is delivered to the smelter, its carburisation, and fusion; and accompanying this is the expulsion of carbonic acid from the limestone, and the union of the lime it contains with the earthy matters associated with the ore and fuel to form a fusible slag.

The circumstance of the different stages of the operation being effected at different temperatures has led some chemists to divide the interior of the furnace into a certain number of spaces or regions, and designate them according to the character of the action which was supposed to be carried on therein.

Scheerer, among others, assigns a distinct zone to the various steps of the process, namely:—

The Warming Zone.—That is the uppermost part of the furnace, twelve feet downwards from the mouth, in which the ascending current of gases imparts a portion of its heat to the materials just entering the furnace.

The Reducing Zone.—That is the next adjoining seventeen feet of the furnace, where the oxide of iron begins to part with its oxygen, and in which, also, the carbonic acid of the limestone is expelled.

The Carburising Zone adjoined to the former, and comprising about nine feet of the height of the furnace, where it is supposed that carbon unites with the iron.

The Zone of Fusion.—Supposed to be the next six feet of the furnace, in which the iron is melted, along with the earthy constituents of the materials, by means of the intense

heat given off immediately below in the fifth, or *zone of combustion.*

It is into the last zone that the blast is admitted, the oxygen of which is converted into carbonic acid, which gas, coming in contact with incandescent coke, or charcoal, generates carbonic oxide to serve as reducing agent in the upper portion of the furnace.

Scheerer states the degree of temperature of those different zones to be 400° C., 1000—1200°, 1600—1700°, 1800°, and 2000—2650° C. respectively.

Tunner, of Leoben, has, by means of different alloys and various metals, attempted to determine the temperatures of blast furnaces, and he further endeavoured to ascertain by actual exposure of ore at different depths of the furnace the exact point at which reduction began and the rapidity with which it was effected. This he accomplished by placing in a box with the top and bottom provided with apertures, so that a portion of the gaseous contents of the furnace passing through its interior might heat and deoxidise any ore placed therein. This apparatus was introduced into the furnace, and permitted to descend to different depths along with the usual materials, and was then drawn up by means of a windlass.

Tunner marks a depth of about 20 feet from the throat as the commencement of the process of reduction, which was reached twenty minutes after the ore was introduced into the furnace, and at which the temperature was as high as 700° C.

Ebelmen, by means of apparatus similar to that employed by Tunner, ascertained that reduction commenced at a depth of 8·2 from the top, and after the ore had been two hours in the furnace, and that it was completed at a depth of 18·9 from the throat after an exposure of 6h. 25m.

These investigations have induced them to assume lines of demarcation in blast furnaces (which are represented in sketches adjoined to the paper).

It is, however, doubtful whether any such lines can be laid down in blast furnaces, because to do this would require that each fragment of ironstone is descending with the same speed as all those introduced at the same time, and that every piece is susceptible of being deoxidised as rapidly as the remainder. Neither of these conditions takes place.

Besides, the friction of the materials against the sides of the furnace, particularly when they reach the slopes or boshes, retards considerably the descent of those portions exposed to its influence. The uniform motion of the mass downward is further liable to considerable disturbance by the smaller pieces of ironstone outrunning the larger by slipping through openings in the contents of the furnace, a mode of progress which cannot happen with those of larger dimensions.

Again, the size of the pieces of ironstone exercises a marked influence on the rapidity of the chemical action which the oxide of iron has to undergo during its passage through the upper portion of the furnace. A piece of ore containing a cubic inch of matter, will be perfectly reduced almost before any action has commenced on a second piece of ore, containing a cubic foot, supposing both pieces travelling side by side. In like manner the expulsion of the carbonic acid from the limestone is influenced.

The same delayed action will happen if a considerable quantity of small material is permitted to accumulate in a given portion of the interior of the furnace; indeed, there is perhaps no circumstance which more frequently deranges the operation than this.

The information which is sought to be obtained respecting the temperature of the different sections of a furnace is attended necessarily with considerable difficulty.

Tunner and Ebelmen's mode of judging of the rate of the reduction might be accepted as an indication of what it is under the most favourable circumstances as to size, inasmuch as in his apparatus of limited capacity he only introduced pieces of ore having very small dimensions. The very circumstance, however, of the mineral being incased within a box, introduces an element of difference between the samples under experiment and those in the furnace.

The lecturer's observations would indicate that the oxide of iron, when exposed to the unimpeded action of the gases of a blast furnace, is reduced at a temperature considerably below that assigned by any of the authorities already referred to, and, further, that the rapidity of the process is materially interfered with by any protection like that involved in the use of such a vessel. In order to form some judgment of the temperature and rapidity with which the oxide in the calcined oolitic ironstone of Cleveland was reduced by means of carbonic oxide, a glass tube was filled with pieces about the size of hemp-seed, and heated short of redness. In this state a stream of carbonic oxide was passed over it, and the resulting gas collected and examined. It contained 96 per cent of carbonic acid. A portion of the iron ore so treated was examined, and found to have in the space of 15 minutes lost 39 per cent of its oxygen.

After this a number of specimens of calcined ironstone were exposed at various times to the escaping gases of the furnaces for periods from 1 to 96 hours. Some specimens were placed on an open tray, others in a perforated box, about 6 or 8 feet from the furnaces in the tube for conducting the gas to the boilers, &c. The furnaces employed varied in height from 48 to 80 feet. The temperature of the gases rarely exceeded the lowest of the figures stated by Scheerer, Tunner, and Ebelmen, and frequently considerably below that. Conceding that the gases from the largest furnaces are the coolest, and from the smallest the hottest, the deoxidation is the most vigorous from the small furnaces, and generally speaking, decreases with each addition to its capacity.

The deoxidation of the iron ore to a certain degree increased with the length of time for which the ore was exposed, and amounted, in one instance, even to 100 per cent; the reduction of the ore placed in a perforated box, and not on an open tray, was sensibly interfered with. (Mr. Bell has adjoined a full list of his experiments to his paper.)

In order to investigate whether the proportion of carbonic oxide contained in the gas might possibly affect the rate of the action on the ore, artificial mixtures containing 13CO, $16CO_2$, 71N, and 32CO, $6CO_2$, 21N, respectively, were separately passed over calcined Cleveland ironstone. Both results proved that almost complete conversion of carbonic oxide in carbonic acid takes place, and that the want of power of deoxidation is not due to a lesser proportion of carbonic oxide.

These and other trials prove that, although mass may retard the action and even delay it until sufficient heat has been imparted, these gases, at a temperature considerably below that stated by the foreign chemists, are sufficient to deoxidise ores of iron.

During the passage of the reduced iron through the furnace, and under the influence of the high temperature to which it is exposed, on its way to the hearth, the metal is apt to carry down some of those substances with which it was originally associated in its ore, or which it meets with in the flux or fuel. To such an extent may this occur that Fresenius quotes a case in which he detects not less than twenty substances other than iron in a specimen he analysed. In some cases as much as 22 per cent of manganese has been found, and above 5 per cent of silicon; but of all those elements mentioned by Fresenius, it is only carbon which may be looked upon as a necessary ingredient of all pig-iron. The circumstances which determine the union of this indispensable element with the metal is one of the highest interest. The portion of the furnace in which the combination takes place, the temperature necessary for effecting it, and the exact source of immediate supply, have engaged the attention of all chemists who have studied the subject. Scheerer assigned it something like the position before described.

Tunner, by means of his perforated box, determined that carburisation did not take place until a depth of 29·8 feet from the top of the furnace was reached, at a temperature of about 1150° C. Ebelmen's idea of the zones of reduction and carburisation is somewhat higher up.

It was next enquired whether it is not highly probable that the box confining the iron ore has not interfered with the action of carburising in the same way as happened, in all probability, with that of deoxidising.

In order to ascertain the extent of change in content of iron, the samples were, after exposure, dissolved in hydrochloric acid, affording, of course, an insoluble residuum.

When a sample of calcined ironstone was exposed for the space of two hours in the waste gas, the residuum was of a greyish colour. The same may be said when the exposure was carried on for three hours with gases produced in the larger furnaces. The smaller furnaces evolve hotter gases —zinc in them frequently melting, and occasionally antimony. The insoluble residuum under consideration, from a specimen after three hours' contact with the hot gases, was blackish, and this went on increasing as the exposure was prolonged, until it became perfectly black. On the other hand, larger furnaces having above 4½ times the capacity (26,500 cubic feet instead of 6000) never gave off its gases, during a period of observation extending over 96 hours, hot enough to melt zinc; for during 72 hours of this time lead melted, and for the latter 24 hours bismuth only was fused. Ironstone exposed during 96 hours only afforded a greyish insoluble residuum on being treated with hydrochloric acid.

From these observations it is concluded that an exposure of three hours to a temperature a little above the melting point of lead and below that of zinc sufficed to give the black colour, whereas at about the temperature at which lead fuses, no period up to 96 hours sufficed to produce it.

On examination the blackening was found to consist of carbon. This carbon, moreover, exists in such a minute state of division as to induce the belief that it is really combined with the iron; and it seems highly probable that the carburisation takes place at that comparatively low temperature. Neither does it appear that anything approaching to complete deoxidation is required, for in one case only 6·10 per cent of the oxygen of the ore was driven off, whilst the residuum was blackish, and with anything like 50 per cent of loss of oxygen, the colour is intensely black. On the other hand, oxygen may be removed to the extent, at all events, of 28 per cent, and no strongly-marked signs of carbon appear in the residuum if the heat during exposure has not reached the necessary point of elevation. In the case of the raw ironstone, the colour was much blacker than when the calcined ore was used.

One duty of limestone in blast furnaces, but not the only one, is to act as a flux, by melting and separating the solid impurities of the ore. It is usually considered that the use of an excess of lime promotes the separation of sulphur, and, it may be, phosphorus.

Mention has already been made of the difficulty of drawing any general conclusions respecting the progress of the operation of smelting from an examination of analyses of the solid contents of a blast furnace. It may be also questioned whether the current of gaseous matter would have anything like a uniform composition over any horizontal section corresponding to the point where the samples were taken.

Considering the properties of carbonate of lime when exposed to heat in an atmosphere of carbonic acid, the problem of drawing, from the presence of this gas, any general inference of the chemical change going on in a furnace, becomes very intricate, if, indeed, not impossible.

This salt of lime parts with half its carbonic acid at a moderate red heat, a much higher temperature being required before the whole is expelled; the last half, more or less, will not be set free until it meets with hot carbon, when it is instantly resolved into carbonic oxide.

Caustic lime is frequently employed in the operation, but this does not simplify the enquiry, but rather the reverse. Up to a temperature of redness, I ascertained lime absorbed carbonic acid in proportion to the temperature to which it was exposed—*i.e.*, the higher the heat the more rapid was the union; this increase went on until 19 per cent of the weight of the lime was taken up, after which a stream of the gas, continued for nine hours, produced no further change. On the other hand, carbonate of lime and caustic lime were subjected to a current of carbonic acid in a porcelain tube, and heated until the latter began to soften. In this case there was no absorption of carbonic acid, and, on the contrary, all the acid was drawn off from the carbonate.

So far as moderate temperatures are concerned, it was ascertained that caustic lime rapidly absorbs carbonic acid from the escaping gases.

(To show the want of uniformity in composition of the gases from different depths of the furnaces, as determined by analyses, Mr. Bell exhibited diagrams, drawn to scale, in which the amounts of carbonic acid and carbonic oxide are represented by darker and lighter shades.)

If the gases of a blast furnace have to furnish us with any data from which we may draw just conclusions of the nature of the chemical action going on in its interior, it appears to me little reliance can be placed on any analyses, excepting those of the gases as they escape.

It is not a difficult matter to calculate what the decomposition of furnace gases ought to be, supposing a certain quantity of coke and limestone to be consumed to the ton of iron, and the sole source of carbonic acid to be the ore by its deoxidation.

Assume the coke used to be 23·20 cwts., and the limestone 11·60 cwts. per ton of pig-iron, containing 19 cwts. of pure iron.

The coke may be taken as consisting of—

	cwts.
Pure carbon	21·80
Ash	1·40
	23·20

And the limestone will consist of—

	cwts.
Lime	6·50
Carbon 1·39, Oxygen 3·71 } to form carbonic acid	5·10
	11·60

The ironstone will consist of—

	cwts.
Iron	19·00
Oxygen	8·14
Earths	22·86
	50·00

The total carbon, then, to be dealt with is, in—

	cwts.
Coke	21·80
Limestone	1·39
	23·19
From which must be deducted the carbon to combine with the iron—	0·74
Leaving to go off as carbonic acid and carbonic oxide—	22·93

The total quantity of oxygen we have in the minerals, applicable to oxidising carbon, is—

	cwts.
In the ore	8·14
In the limestone	3·71
	11·85
To which may be added from the decomposition of water contained in the blast—	00·85
	12·70

To convert 22·93 cwts. to the state of carbonic oxide, there will be required of—

	cwts.
Oxygen	30·57
But, as applicable to these, we have in the limestone 3·71, and in the water in the blast 0·85—	4·56
To be derived from the atmosphere	26·01
26·01 atmospheric oxygen is equal to nitrogen—	87·07
8·14 oxygen in the ore will give of carbonic acid, generated by its action on carbonic oxide—	22·38
22·38 carbonic acid contains 6·10 of carbon, having 16·83 (22·93–6·10) to give of carbonic oxide—	39·27
	148·72

Supposing, then, the carbonic acid from the limestone to be decomposed, and that generated by the reduction of the ore to escape as such, the proportions in which nitrogen, carbonic acid, and carbonic oxide should be found in the escaping gases would be—

Nitrogen	58·54
Carbonic acid	15·05
Carbonic oxide	26·41
	100·00

Analyses of the gases from a blast furnace, melting forge iron with precisely the quantity of materials named in the above calculations, show figures in a close approximation to the theoretical calculation.

We will now devote a few minutes to an examination of the blast, by means of which we obtain heat from the fuel to fuse the iron slag, and generate carbonic oxide to effect the reduction and carburisation of the metal which is the object of the process.

The effect of cold on our atmosphere being to deprive it of a considerable portion of its moisture, and to contract its bulk, a cubic foot of air in winter contains, of course, less watery vapour and more oxygen than is embraced within the same space in summer.

The chief recommendation of the hot blast is the economy of fuel obtained by means of its use; and it is this attribute which possesses interest to ourselves as chemists, furnishing as it does a field of enquiry into the nature of combustion, and the appropriation of heat in blast furnaces.

If it can be shown that the progress of smelting science has been such as to reduce the consumption of coke in a furnace blown with cold air until it is within 10 or 11 cwts. per ton of iron of that used in a furnace supplied with air heated to 339° C., this is the saving we are called upon to explain.

Granting, then, for the present moment, that such saving, under the circumstances named, may be realised, it is to be remembered that the blast has the 339° of heat communicated to it by means of 5 cwts. of coal, of which, I have ascertained, more than one-half is wasted in the hot-air apparatus; so that, practically, you have the heat of 2 cwts., or barely that, of fuel burnt outside the blast furnace, effecting a saving, in that burnt in its interior, of 10 to 11 cwts.

In practice, we are pretty near the truth in accepting as a fact, that an estimate of heat developed by the blast on the coke is obtained by considering its oxygen converted into carbonic oxide; for, although at the instant of its admission carbonic acid is generated, this substance is almost as rapidly converted into carbonic oxide by the action of the candescent coke. But, in the hot-air stoves, the 2 cwts. of carbon are converted permanently into their highest state of oxidation; and, taking the units of heat as 2221° C. for burning carbon to carbonic oxide, and as 7900° C. for burning carbon to carbonic acid, the 2 cwts. burnt in the stove will represent 7·11 cwts. of carbon burnt in the furnace, or, say, something like 7½ cwts.

In round numbers, therefore, we may consider 7½ cwts. of our saving of 10 or 11 cwts. to be accounted for, leaving still 2½ or 3½ cwts. for further investigation.

Now, let us assume that the coke required is 40 cwts. for the ton of cold blast iron, and in the furnace, blast heated to 339° C. is suddenly introduced, which is equal in caloric power to 7½ cwts. of coke; so that, so far as a mere question of heat is concerned, something like 47½ cwts. of coke is being applied to the production of a ton of metal for which 40 cwts. will suffice.

A common yield of calcined clay ironstone is 40 per cent; so that 50 cwts. are required for a ton, to which has to be added, say 12 cwts. of limestone.

The burden, then, for 1 ton of cold blast iron would be—Coke 40 cwts., calcined ironstone 50 cwts., limestone 12 cwts.; but, by the addition of the equivalent of 7½ cwts. of coke, these proportions will require a corresponding modification, and a ton of iron will be represented by heat in blast 7½ cwts., and in coke 32½ cwts., together 40 cwts.; calcined ironstone and limestone, as before, 62 cwts. together.

But what is the effect on the furnace itself by such a change in the proportion of its contents? To answer this, let us imagine a furnace with a capacity of 6,000 cubic feet.

The weights of the materials used at the Clarence Works have been carefully ascertained; and it was further determined that the weight of material in a furnace, before being lighted, was such as to cause a compression like 25 per cent; so that a furnace of 6,000 cubic feet would contain 7,500 cubic feet of materials, as measured in the charging barrows.

It therefore appears such a furnace, working on cold blast, would contain—

	tons.
Coke	56
Calcined ironstone and limestone	87
	143

But, introduce the air, heated so as to reduce the coke to about 30 cwts. to the ton of iron, and the furnace would contain.

	tons.
Coke	50
Calcined ore and limestone	103
	153

It would be almost impossible to ascertain to what extent these figures become modified by the action of the heat when the furnace is in blast, or what the effect of the altered proportions would be on the temperature of the ascending gases. To obtain the exact figures for this, we ought to have the specific heat of all the various materials in the furnace.

That the withdrawal of so many cubic feet of coke, and its substitution of substances nearly three times its weight, and with a mean specific heat rather higher than that of the coke itself, must permit a more perfect absorption of heat from the ascending current of gas, is obvious.

Looking at the complicated nature of the problem, it appears as if there is no alternative left but to ascertain the actual amount of heat carried off in the escaping gases, after they have performed their work in the furnace; and this, during a whole day, was done at the Cyfarthfa Works, in a hot and cold blast furnace.

The temperature of the gases was ascertained by a pyrometer, consisting simply of a copper tube, about 3 feet long and 1 inch diameter, closed at the lower end, and screwed into a Bourdon's pressure gauge.

The gases were assumed to contain according to weight—

$$9CO_2,\ 32CO,\ 59N = 100.$$

	cwts.		cwts.		cwts.
The C in CO_2 = 2·45;		C in CO = 13·71.		Total C...	16·16
The O in CO_2 = 6·55;		O in CO = 18·29.		Total O...	24·84
Total	CO_2..9·00.	Total	CO...32·00.	Total	C+O 41·00

	cwts.	cwts.
Coke used per ton of iron was—		34·80
Deduct ash (5 per cent).....	1·74	
Deduct HO (5 per cent).....	1·74	
Deduct for combination with iron	0·74	
		4·22
		30·58
Carbon in limestone.....		2·12
Total carbon going off in gases....,..		32·70

With the composition of the gases given above, the carbon will be volatilised in the following state:—

	cwts.
CO_2.....	4·96
CO.....	27·74
	32·70

	cwts.
C 4·96, for conversion to CO_2, requires O....	13·23
C 27·74, for conversion to CO, requires O.....	36·99
32·70 Total O.....	50·22

But in the materials themselves there is—

O in the CO_2 of the limestone used (17·66 cwts. per ton of iron).....	5·65
O in 48·43 ores (part of Fe being as FeO)	7·35
	13·00
Having to be supplied by blast of O.....	37·22

The total weight of the gases would then be—

	cwts.
Carbon.....	32·70
Oxygen.....	50·22
Nitrogen, accompanying 37·22 O of blast	124·60
Water in coke 1·74; water in ore 2·19....	3·93
	211·45

We have a total weight of gases—

	cwts.
C 4·96 + O 13·23 = CO_2..... ..	18·19
C 27·74 + O 36·99 = CO.....	64·73
N	124·60
HO.....	3·93
	211·45

The mean temperature of these gases as they left the furnace was ascertained to be 445° C.

By multiplying these weights by their various specific heat and temperature we have—

$$\left.\begin{array}{l} CO_2\ 18{\cdot}19 \times 0{\cdot}212 \times 445^\circ \\ CO\ \ 64{\cdot}73 \times 0{\cdot}288 \times 445^\circ \\ N\ \ 124{\cdot}60 \times 0{\cdot}275 \times 445^\circ \\ HO\ \ 3{\cdot}93 \times 1{\cdot}000 \times 445^\circ \end{array}\right\} \ldots\ldots\ldots 269{\cdot}67$$

And this divided by 2221 units of heat burning C to CO, gives 12·16 cwts. of carbon, or, say, 12·76 of dry coke, as going off with the escaping gases from the cold blast furnace.

In the case of the hot blast furnace, with air heated to 320° C., the calculation stands thus:—

	cwts.	cwts.
Coke used per ton of iron was.....		26·74
Deduct ash in coke (5 per cent)....	1·33	
" HO " (")....	1·33	
" C to combine with iron.....	0·74	
		3·40
		23·34

Lime added in caustic state; hence there is no carbon to include from this source. Upon the same basis as the previous calculation, the carbon will be given in the gases as—

	cwts.
CO_2.....	3·53
CO.....	19·81
	23·34

	cwts.		cwts.
C	3·53	requires for conversion to CO_2 of O	9·41
C	19·81	" " " CO of O	26·41
23·34			35·82
Less O in the ores, part existing as FeO....			8·12
Leaving O to be supplied by blast.....			27·70

Total weight of gases will be—

	cwts.
Carbon.....	23·34
Oxygen.....	35·82
Nitrogen accompanying 27·70 O.....	92·73
Water in coke, 1·33, in ore, 1·73....	3·06
	154·95

The mean temperature of the gases is ascertained to be 477° C., and their estimated constitution would be as follows:

	cwts.
C 3·53 + O 9·41 = CO_2.....	12·94
C 19·81 + O 26·41 = CO.....	46·22
N.....	92·73
HO.....	3·06
	154·95

By multiplying these weights by temperature and specific heat we have—

$$\left.\begin{array}{l} CO_2\ 12{\cdot}94 \times 0{\cdot}212 \\ CO\ \ 46{\cdot}22 \times 0{\cdot}288 \\ N\ \ 92{\cdot}73 \times 0{\cdot}275 \\ HO\ \ 3{\cdot}06 \times 1{\cdot}000 \end{array}\right\} \times 477^\circ = 21274$$

This divided by 2221 = 9·57 carbon, or dry coke, 10·04.

	cwts.
Now, as the weight of coke per ton of iron escaping represented in heat from the cold blast furnace has been shown to be	12·76
Whereas with hot blast it is only.....	10·04
It follows there is escaping from the former above that going off from the latter heat equal to coke.....	2·72

We have the total saving of coke as follows:—

	cwts.
1st. By use of blast heated as formerly stated	7·50
2nd. By diminution of loss of heat in the escaping gases.....	2·72
	10·22

which accords with the saving stated to be effected by the use of 5 cwts. of coal, of which only about 2 cwts. were really available.

Mr. Bell concluded his paper by giving in detail several other comparisons of two different furnaces carried on with cold and hot blast respectively.

The President, in inviting discussion, said—There is scarcely any branch of manufacture which requires so many various qualities of a rare and high kind as this particular one in which Mr. Bell is pre-eminent, and, certainly, among iron-masters there is none equal to himself in the combination of those various qualities. His scientific skill and industrial vigour have led to the construction of iron furnaces which are unsurpassed in the perfection of the operations which pertain to them. The subject is one so complicated that Mr. Bell's views will be considered exceedingly valuable in relation to it, and, certainly, all will feel interested in having so full and so masterly an exposition from himself in this matter.

Mr. Siemens—With regard to the saving effected by hot blast, a great deal of controversy has taken place, and I am very glad to see that Mr. Bell has really tackled the question by reducing it to figures. At first sight it appears strange that the combustion of 2 cwts. of carbon added to the blast should save 10 cwts. of coal in the blast furnace; but a little consideration, I think, would bring us already to this conclusion. If the result of combustion was carbonic acid only, then every 6 lbs. of carbon added in the shape of heat to the blast would necessarily save 14 lbs. in the furnace, that being the proportion of heat developed in burning carbon into carbonic oxide and into carbonic acid; but we find the result of combustion is not carbonic oxide but a mixture of carbonic oxide and carbonic acid. It may be assumed to be, in a furnace worked with hot blast, 1-5th carbonic acid and 4-5ths carbonic oxide; and, if we take these proportions, we shall find that the effect of 1 lb. of combustion outside the furnace would probably produce a saving of 4 lbs. inside the furnace. But why is the saving greater? If we suppose that a mixture of air, reduced ore, and carbon, comes down the furnace, and it is met by the blast, the first action is complete combustion into carbonic acid; but almost simultaneously with that action the reducing action, or the absorbing action of the carbonic acid upon carbon, takes place also. The carbonic acid is reduced to carbonic oxide, and this reduction is accompanied by a great refrigerating effect. If cold blast is used, there must be a larger proportion of carbon present with the ore, and there must be a larger surface of carbon at once exposed to the carbonic acid formed in order to effect its reduction. It has been determined practically that a cold blast furnace not only works hotter at the top, but that the proportion of carbonic acid is greater in the case of a hot than a cold blast furnace; it would, therefore, follow that the hot blast has not only produced a higher temperature at the bottom, but reduced a mixture of carbonic oxide and carbonic acid, giving larger margin of heat developed, or less refrigerating action introduced by the formation of carbonic oxide. Perhaps Mr. Bell will be kind enough to tell us whether, on raising the temperature of the blast, the proportion of carbonic acid gas at the top of the furnace is not increased.

Mr. Bell—If you had a hot and cold blast furnace working together, irrespective of the results, with the same quantity of fuel, and the same quantity of ore, then the comparison Mr. Siemens is making would be a perfectly true one. But it happens to be the case that, upon a comparison of the Clairvale furnace, blown with a hot and with a cold blast, you find the volume of carbonic acid in the cold is considerably greater than that in the hot.

Dr. Paul—If we compare two furnaces, one worked with cold blast, and burning fuel at the rate of 2 tons for each ton of iron produced, and a hot blast furnace, worked so that the consumption of the fuel is at the rate of only 1 ton for each ton of iron produced, we must remember that, in fact, the largest proportion altogether of the materials passing through those furnaces in both cases is the air by which the combustion is supported. Therefore, taking it for granted that in both cases the discharged gases go away at the same temperature, we have in the one blast furnace twice the amount of gaseous material passing through the furnace, and twice the quantity of heat being carried off in that escaping gas. Therefore, it is evident that the quantity going away to waste in the cold blast furnace is twice as great as in the hot blast furnace, and if we had the waste twice as much in the one case as it is in the other, it is very evident that in the hot blast furnace there must be very considerable saving.

Captain Noble—With respect to the ratio between carbonic acid and carbonic oxide in the waste gases, Mr. Bell has found that, within a very short time, and while apparently the furnaces are working precisely the same, there is a very great difference in their ratio. I entirely agree with what Mr. Bell has said, and I believe very little in the analyses of tunnel-head gases. The analyses of gases taken from pipes are, I believe, entirely fallacious. It is almost impossible to believe that ratios in crooked lines, like what we see on the diagram, can really exist in a furnace, and it is very evident that when we take gas from a furnace by means of a small pipe, the nature of that gas will change very much in accordance with the last substance with which the gas has come into contact—whether it be coke, for example, or whether it be ironstone. I have had occasion myself recently to make an investigation with reference to the determination of the number of units of heat produced in a furnace, and what became of them. In so doing, I have endeavoured to trace the number of units of heat that go away with the tunnel-head gases, and which are re-produced again when the tunnel-head gases are burnt, and so on. And, finally, I have worked it out in the work that is done by the engines and other means. The great variations that Mr. Bell has found in his analyses of his gases from the pipes is entirely confirmed in another way, and that is, by the amount of water vaporised. In the space of three or four hours the amount of water vaporised varied most enormously, and, if I remember right, Mr. Bell found a variation in the ratio of the carbonic acid amounting to something like 20 per cent of the whole amount. The ratio also varies much in the different furnaces.

Mr. Crossley—It is certainly surprising to find that iron absorbed carbon at so early a stage in the furnace. I have passed pure carbonic oxide over pure sesquioxide of iron, and I never noticed any deposition of carbon, and I am rather afraid that, in the case of Mr. Bell, the calcined stone has not been fully calcined in the interior of the stone, and perhaps the carbon which he has obtained in the deposit is the carbon which was left in the stone. Mr. Bell has also told us something which I consider very interesting in reference to the proportion of limestone that may be used in a furnace, and he stated that the smaller the quantity of limestone used the larger the percentage of sulphur which comes off in the pig-iron. We tried some years ago some experiments in which we used 3½ cwts. of limestone, 7 cwts, and, I believe, 14 cwts., and we have found that the silicon and the sulphur in the iron came off in larger quantities in the iron where the smallest quantity of limestone was used, and there was a smaller proportion of metallic bases in the pig-iron produced from the smallest quantity of limestone.

Mr. Cochrane—I shall be glad to offer a few observations on the subject of hot blast, which has been rather a pet subject with me for a great many years. I believe it is an admitted fact, that the colder oxygen is, and, of course, the more dense it is, the more intense is the action of combustion due to that oxygen, and that there is no advantage in warming it. But not so, I believe, with nitrogen, and, of course, with the mixture of atmospheric air. I think that the question of heating that mass of nitrogen has been rather overlooked in the paper; and not only has an enormous amount to be heated in the furnace, but, I believe, a greater weight of nitrogen has to be heated for every ton of iron that is reduced. Mr. Bell has alluded to a dark appearance before the tuyere. It is notorious that this dark appearance extends, in many instances, to a long tube, right into the centre of the cold blast furnace; and that is really part and parcel of the heating apparatus which enables the blast to be delivered in the cold blast furnace at the requisite temperature for the quality of iron required. Hence it needs the element of time of combustion to be taken into account, or not the time of combustion rather, but that the

material—the coke—is, in being burnt, higher in a cold blast furnace, by reason of the time required for heating all the nitrogen, and so on, than is the case in a hot blast furnace, where you start with temperature of, we will say, 1000° F., and where there is no longer any necessity for heating that blast inside the furnace. The zone of fusion is spread lower down the tuyeres, and so, *pro tanto*, you gain in height of furnace.

Mr. Bell—I will not take up many minutes in replying to the questions which have been put before us. One point raised was as to the greater volume of gases escaping from a cold blast furnace than from a hot. Well, I have not given figures on that point, because, as I stated before, I have intruded too long upon the company already. But it was, of course, impossible to ascertain the quantity of heat escaping by the gases at a certain temperature, unless I had known the quantity of gases escaping, which was a necessary element in the calculation. With respect to the observations of Mr. Crossley, with regard to the possibility of the carbon in the ironstone being the cause of the deposition of the carbon in the iron, I would remind him that a certain temperature was required. If this was deposited from the carbonic acid already existing in the iron ore, how did it happen that it never found its way there, when it was exposed merely in a blast furnace having the escaping gases going out at a temperature something like melting lead? There was an invariable connection between the temperature of the escaping gases and the appearance of this carbon. With regard to my friend Mr. Cochrane, all I can say is this, that I am not prepared to dispute whether it is better to heat the oxygen or better to heat the nitrogen. But this appears to me quite certain, that, as you look upon the blast as a mere vehicle for conveying the heat, it is a matter of perfect indifference whether the heat is carried in by 8 lbs. of oxygen or 14 lbs. of nitrogen.

I have made diagrams, not from imagination, but based upon actual analyses of the gases, to show that, at a given point, the whole of the oxygen of the blast is absorbed, and whether the blast went in hot or cold appeared to make no difference. The carbonic acid was as readily reduced to the condition of carbonic oxide in the hot blast as in the cold. The figures before you illustrate quite truly the temperature of the gases as they were coming from two furnaces and at different periods of the day; and they merely show the irregularity of action of all blast furnaces, and how impossible it is, from a few observations, to draw any general expression as to their action.

Mr. W. Chandler Roberts then gave a verbal account of, and exhibited the apparatus for showing the expansion of palladium by hydrogenium. It consisted of a coil formed with a strip of palladium and a strip of platinum, each being 300 m.m. long, 3 m.m. wide, and 0·3 m.m. thick. This is put into a glass vessel filled with acidulated water; a plate or wire of platinum is placed near it, and the ribbon or wire connected with either pole of a battery by means of a commutator. The coil is first connected with the zinc pole of the battery, hydrogen is then thrown on the surface of the palladium, when the gas is absorbed and the spring opened. The direction of the current being reversed, oxygen is thrown on the surface of the metal, which consumes the previously occluded hydrogen and causes the index to move rapidly back to zero.

May 20th, 1869.

Dr. A. W. Williamson, F.R.S., *President, in the Chair.*

The minutes of the preceding meeting were read and confirmed.

The following certificates were read:—

For the first time—Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. Fletcher Barrett, Lecturer on Physical Science at the London International College.

For the second time—Wm. G. Valentin, Assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gilham Hewlett, Surgeon, Bombay Army, Health Officer City of Bombay, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A. Oxford, Sympsham Rectory, Weston-super-Mare.

The President announced that, in accordance with a letter he had received from M. Dumas, the Committee had made arrangements for the inaugural Faraday discourse to be given by M. Dumas on the 17th of June, and for the banquet to take place on the 18th.

The Secretary then read a short paper by Dr. Schorlemmer, "*On the Constitution of Hyposulphurous Acid.*" The author referred to the experiments of Dr. Dupré, and the views lately expressed by Dr. Odling, which seemed to be supported by Rose, who states that no hyposulphite is capable of existing which does not contain at least one atom of hydrogen, and proposes to reduce the molecular weight of hyposulphurous acid to one-half. The author thought that it could not be generally known that Rose's statement was incorrect. Pape * found all the hydrogen present in the form of water of crystallisation, which, with care, could be expelled without the salt being decomposed; but the last portion of the water is driven off at a temperature only a few degrees below that at which decomposition begins. By heating the sodium, potassium, and barium salts to 215° C., they can be obtained anhydrous, while at 5° higher they decompose. The lead-salt is anhydrous at 100°, but at a few degrees higher it blackens. In many reactions, the molecule of hyposulphurous acid split up in such a way that the atom of sulphur previously contained in the sulphur dioxide remained in the oxidised state, whilst the other atom separated as free sulphur, or a sulphide—

$$Na_2S_2O_3 + 2HCl = 2NaCl + H_2O + SO_2 + S.$$
$$Ag_2S_2O_3 + H_2O = Ag_2S + H_2SO_4.$$
$$Hg_2(NO_3)_2 + Na_2S_2O_3 + H_2O = 2HNO_3 + Hg_2S + Na_2SO_4.$$

The author, therefore, thought that the old formula, proposed by Dr. Odling fourteen years ago, must be retained for hyposulphurous acid, and that it must be considered as sulphuric acid, in which one atom of oxygen had been replaced by sulphur.

Dr. Odling referred to the discussion which followed the paper by Professor Stokes, "On a Certain Reaction of Quinine," when, in speaking of the non-fluorescence of the hyposulphite, he ventured to say that it might be that, after all, the compounds of hyposulphurous acid were not really oxygen salts, but that they were, instead, halogen salts; and, in favour of that view, he had quoted the observation of Rose, but he was not aware that this observation had been refuted. He (Dr. Odling) would like to call to mind the different views put forward with regard to the hyposulphites. Having regard to empiric formulæ only, such a salt as sulphate of soda is represented as Na_2SO_4. The pentasulphide of sodium has the formula Na_2S_5, so the S_5 might be taken to correspond with the S and the O_4. The next salt in the list would be the intermediate one, $Na_2S_2O_3$, the ordinary mode of expresssing hyposulphite of soda. In Sir Robert Kane's "Manual of Chemistry," a salt was described having the composition $Na_2S_3O_2$, and it was said that this salt crystallised with the same number of atoms of water of crystallisation as the hyposulphite, and was isomorphous with it. Then there only wanted the intermediate salt, Na_2S_4O, of which he (Dr. Odling) had never heard; but, admitting the existence of the salt described by Sir Robert Kane, and accepting the other formulæ, they would have a complete series, as follows:—

Na_2SO_4
$Na_2S_2O_3$
$Na_2S_3O_2$
Na_2S_4O
Na_2S_5,

* *Poggendorff's Annalen*, cxxii., 408.

a series which seemed natural and likely to exist. If they oxidised sulphite of soda by any means, it became Na_2SO_4; and, if instead of oxidising it, they sulphurised it, it at once became $Na_2S_2O_3$; there was, therefore, an analogy in ultimate formulæ, and also an analogy in the particular mode of formation. Professor Kolbe had succeeded in making formic acid by reducing carbonic acid with sodium, thus: $H_2CO_3 + Na_2$; and there was produced in this way formiate of soda, $NaHCO_2^{\cdot} + NaHO$, which remained combined with the excess of carbonic acid. This reaction was, at first sight, very similar to the ordinary reaction by which a hyposulphite was obtained by the action of sulphurous acid. The hyposulphite could be obtained very readily by dissolving zinc or iron in sulphurous acid, but they would use sodium, as before, and they obtained a result which is capable of being expressed thus: $H_2SO_3 + Na_2 = NaHSO_2 + NaHO$, which remains combined with the excess of sulphurous acid employed. This fact had led Dr. Dupré to form the opinion that carbonic and sulphuric acids were the analogues of each other. He (Dr. Dupré) made several experiments by acting upon carbonates with carbon, and the result of these experiments led him to believe that he actually formed formic acid. But the experiments, as Dr. Dupré acknowledged, could not be considered as altogether conclusive. With regard to formic acid, all experimental evidence tended to show that they had the carbon united with hydrogen and with oxygen, and also with oxygen already combined with hydrogen. But if they were right in saying that sulphurous acid was not an oxygen acid, the formic acid would be represented by $H(HO)CO$, and the hyposulphurous acid by $HHSO_2$, in which both of the hydrogen atoms are directly combined with sulphur. He (Dr. Odling) did not see that they were obliged to retain the old formula; the question was still an open one, and he thought the facts brought forward by Mr. Schorlemmer were as explicable to the new as to the old views.

The speaker then referred to the reactions which Mr. Schorlemmer gave, both of which, he thought, could be applied to the new way with as much or more ease than to the old. In speaking about the atom of water, Dr. Odling said that if they represented hyposulphite of soda according to the old-fashioned view, they had $Na_2S_2O_3H_2O$; but he preferred to write it $2NaHSO_2$. The salt retained its atom of water with great firmness. It required a heat of 215° to drive off that atom of water from it: soda, silver, and baryta salts also required this unusually high temperature. This did not prove that the atom of water was different from water of crystallisation, but it was in favour of that view. He had said that it was impossible to drive off this atom of water, but, corrected by Mr. Schorlemmer, he would say simply that it was difficult.

Dr. Odling concluded by saying that it was a question on which he retained his mind quite open to bend in either direction as fresh facts arose, but, at the present moment, he did not think there were sufficient facts to enable them to absolutely decide the question, either one way or the other.

The President, in proposing a vote of thanks to Mr. Schorlemmer and Dr. Odling, thought there were two or three points brought forward by Mr. Schorlemmer which were entitled to some weight. First there was the tendency of hyposulphurous acid to form double salts of silver, sodium, &c. Among the characteristics of bibasic acids, that was one of the most conclusive; as a rule, and he (the President) thought it should weigh in Dr. Odling's mind as an argument in favour of the bigger formula. In reference to the decomposition into sulphur and sulphuric acid, it occurred to him whether there was not a difference in degree between believing that to occur by the splitting of the molecule, and believing it to occur by an action of the two molecules. There were cases which pointed to the greater facility for assuming that the result was an action in one molecule, than that it was an action of two molecules one upon another.

Mr. F. Field, F.R.S., then submitted a specimen of, and read a note on, sulphate of alumina from Iquique, Peru.

The following is the analysis, after deducting small quantities of chloride of sodium, oxide of iron, and silica:—

Sulphuric acid	35·56
Alumina	15·88
Water	48·56
	100·00

Corresponding to the formula $Al_2O_3,3SO_3+HO$, which requires—

Sulphuric acid	35·93
Alumina	15·57
Water	48·50
	100·00

Mr. W. H. Perkin, F.R.S., then read a note "*On Regnault's Chlorinated Chloride of Methyl*," of which the following is a condensed abstract.

Last year the author read a paper before the British Association "On the Chloride of Methylene, obtained by the Action of Nascent Hydrogen on Chloroform," which was afterwards published in this journal (Chemical News, vol. xviii., p. 56, *Eng. Ed*). The chloride of methylene obtained from chloroform was found to boil at about 41° C., the same temperature as that at which Butlerow's chloride of methylene boils. As Regnault gives the boiling point of chlorinated chloride of methyl much lower, namely, 30·5°, the author had made a fresh examination of the substance, to see if it were an isomer of chloride of methylene. After preparing a quantity of this substance, it was found to have a boiling point of between 40° and 42° C., and apparently to be identical with the chloride of methylene from chloroform. The author, however, has not yet completed its examination. Its composition was determined by its analysis and vapour density.

The President, in thanking Mr. Perkin for his communication, remarked that the experiments were strictly allied to a theoretical question now at issue amongst chemists, viz., that atoms had got bonds to them which were supposed to have different properties, and, accordingly, yielded different products.

Dr. Hugo Muller stated that he had made some experiments, with the view of finding out a good method for producing chloride of methylene; however, he found that at the best it was a long and tedious operation. The best result he obtained by simply dissolving the chloroform in alcohol, and adding hydrochloric acid and zinc with a few drops of platinum chloride. The whole is warmed slightly, in order to distil off the chloride of methylene as soon as it is formed, otherwise it is further acted upon and lost. He was trying some experiments with the object of obtaining bromide of methylene from bromoform, but the difficulty of obtaining the latter in quantity prevented him from going on with the experiment. He would be glad to hear of a practicable method for obtaining bromoform.

Dr. Mills said it might easily be obtained by treating dicitrates with an excess of bromine. He had obtained a large quantity in that way.

Dr. Muller had got, on the contrary, very unsatisfactory results with this method. The yield was very small in proportion to the citric acid used.

Mr. Bassett had prepared, or attempted to prepare, bromoform in the way described by Dr. Mills, but he also found that the yield was exceedingly small—a very poor product.

Mr. Perkin mentioned that he was at present engaged in an investigation of Bunsen's gaseous bromide of methyl.

The meeting was adjourned to the 3rd of June.

NEWCASTLE CHEMICAL SOCIETY.

A special meeting of members of the Newcastle Chemical Society was held, on May 6th, in the theatre of the Newcastle College of Medicine, for the purpose of hearing a paper read by Mr. Ludwig Mond, on "*The Recovery of Sulphur from Alkali Waste.*"

In the absence of the President, whose paper on the "Blast Furnace" was read that evening before the London Chemical Society, Mr. John Glover occupied the Chair.

The Chairman said that, as they were all aware, Mr. Mond was the patentee for the recovery of sulphur from tank waste. Of the importance of that discovery to the chemical trade of this district there could not be two opinions. He trusted that Mr. Mond would enable them, to some extent, to supply a felt want in the chemical trade in this district—namely, the profitable treatment of tank waste.

Mr. Mond, at the outset, said that thousands of pounds had been spent by chemical manufacturers to utilise the waste, or to carry it away, and no one but has had his nose offended and his appetite spoiled by going near waste heaps. In 1860, he commenced, in a chemical manufactory in Germany, a series of experiments on several processes for the recovery of sulphur from waste, and took out a patent in December, 1861. When he came to England (at the time of the Exhibition) he found, to his surprise, that a process, somewhat resembling his own, had been proposed as early as 1836. At the same time as himself, three different parties—in Glasgow, in Newcastle, and in Bristol—had been working in the same direction. His process, however, had clearly the merit of being the first that extracted great quantities of sulphur, and did away with the waste nuisance. He found the process a more expensive one in this country, where labour was dearer than in Germany. He found a difference in the English waste and that which he had been formerly accustomed to. In September of 1863, he took out the new patent. He had previously experimented on tank-waste, and had obtained as much as 55 per cent of sulphur. The first to introduce his process on the Tyne was the Tyne Chemical Company, at South Shields. He believed that the waste of this district was more suitable for using his process than that of Lancashire, as being somewhat more porous. Mr. Mond then explained, by means of a diagram, the working of his process, and exhibited specimens of the sulphur obtained from the waste. He calculated that the cost of extracting the sulphur from the waste would be £1 per ton, but the profit to manufacturers would be about £4 per ton (at Messrs. Hutchinson's, it cost £1 5s. 5d. + 15s. for royalty = £2, working on a comparatively small scale). The cost of the apparatus he calculated to be £1,509, or (providing for all contingencies) £1,660. He thought that the alkali manufacturers ought to be satisfied with the process in a mercantile point of view, and, also, as it enabled them to remove a great nuisance.

The Chairman said that, whatever might be the opinion of the meeting as to the value of the paper—and that it was of great value no one could doubt—they were under a great obligation to Mr. Mond for the trouble he had taken in bringing so important a subject so very elaborately before them. He had no doubt that some of the gentlemen present would be able to offer comments on the process; he therefore invited any comments on or criticisms of the process, as detailed to them.

In reply to Mr. Archibald Stevenson, South Shields, Mr. Mond said that the waste treated in Holland during four years had been used for a great many purposes. The new station at Utrecht had been built on waste, and a number of the houses had been built upon it. A well, used for domestic purposes, had been sunk through the alkali waste, and the water, though very hard, employed for domestic purposes.

Mr. Pattinson begged to move a vote of thanks to Mr. Mond for his very valuable paper. It appeared to him that Mr. Mond had solved the problem of disposing of soda waste. When the subject of utilising the waste products was mentioned to him, he had always said that the principal objection was the expense, and it was believed that the substance recovered would not pay the expense of the recovery. Mr. Mond had discovered a process by which they could recover sulphur from waste at a cheap rate; and, therefore, chemical manufacturers ought to be obliged to him for his discovery.

Dr. Lunge, in seconding the proposition, said that there were two other processes—Schaffner's process and Hofmann's process—both of which involved a very large amount of labour. They involved the removing of the waste from the vat, exposing it to the action of the air for several weeks. He was in Germany last year, and visited a chemical manufactory where Schaffner's process had been introduced. He was told by the manager that they were modifying that process, and bringing it nearer to Mond's process. Schaffner's process had been given up wherever it had been worked, and Mond's process introduced—at least as far as the blowing of air and the decomposition of the liquors were concerned. The only detail of Schaffner's process retained, was the way in which the sulphur was converted into *roll*. As to Hofmann's process, Mr. Bell had mentioned, at the last meeting, that, in his opinion, Mr. Mond's process was a decided improvement on that process.

The Chairman said that Mr. Mond's process had been alluded to in the report of the commission appointed by Government with regard to the pollution of rivers. It might be that this process could be easily adopted; and, so far as chemistry was concerned, it was easy. But they must remember that there was an increasing manufacture of bleaching powder and of bi-carbonate of soda, and that these manufactures took up the whole of the muriatic acid. The muriatic acid required in Mr. Mond's process would, therefore, be taken up in the manufacture of bleaching powder and bi-carbonate of soda. Thus, though the process was in itself valuable, seeing that it would, to a considerable extent, interfere with the manufacture of bleaching powder, its adoption for the purpose of reducing the nuisance felt from alkali waste was likely to be very limited.

Mr. Mond acknowledged the vote of thanks accorded to him for his paper, and, in reply to the remarks of the chairman, said that he would like to have an opportunity of going more fully than he would then be able to do into the question of utilising muriatic acid. As he had stated at the end of his paper, about 100,000 tons of strong muriatic acid flowed into the Tyne from alkali works during one year—or acid equal to 100,000 tons of strong muriatic acid. Believing that many manufacturers would be astonished at these figures, he explained how he had arrived at the conclusion. He found that so much salt was decomposed on the Tyne in the year, equal to so much strong acid. Now, the bleach and bi-carbonate made were also known; and, allowing quantities, very liberally calculated, for their preparation, he arrived at this remainder. The quantity of muriatic acid used for bleaching powder was considerably in excess of what was required. He believed that few manufacturers would be unable to find sufficient acid with which to treat their waste.

Mr. Scholefield thought that Mr. Mond's figures were erroneous.

Mr. Mond said these were the figures given by Mr. Richard Cail, as Secretary to the Alkali Association, who, if he had been present, might have given them better information on the question than he could supply.

Mr. Scholefield said that, if he had received information, he would have provided himself with correct details on the subject.

The Chairman thought that the figures given by Mr. Cail were likely to be quite correct.

Mr. Mond said that the quantity of acid required to do away with the waste nuisance was from 20 to 25 per cent of the acid. From 1866, the production of bleaching powder had greatly increased, but the production of bi-carbonate had

not increased; the amount produced was not at all equal to that in 1866; and it was, therefore, likely that there would be a good deal of muriatic acid to spare.

In reply to a question, Mr. Mond said that the amount of brimstone used in England was 50,000 tons a year, and that the total amount exported from Sicily was 300,000 a year.

In reply to another question, Mr. Mond said he calculated that 40,000 tons of sulphur could be utilised from alkali waste in England in one year.

The meeting then separated.

PHARMACEUTICAL SOCIETY.

Adjourned Meeting, Wednesday, May 5th, 1869.

H. Sugden Evans, Esq., *Vice-President, in the Chair.*

Mr. Carteighe recommenced the discussion of the subject introduced by Professor Redwood at the previous meeting. He did not agree with the most important practical suggestion made by Professor Redwood, viz., that in which he proposed to bend and modify the existing system of weights and measures, so as to gradually merge the one system into the other; there were great objections to such a process of bending.

The *tetram* or 4 gramme weight (one of the integers proposed by Professor Redwood) might be divided into tenths or into halves, quarters, &c., but they could not, as upholders of the decimal system, sanction the recognition of the octavial system involved in the latter. He did not think it would be easier to remember that the *tetram* was equal to one dram, and hence to four grammes, than to recognize the value of four grammes as such. He would rather suggest that a knowledge of the decimal system should be required by the Board of Examiners, and a book might be compiled as an addition to the British Pharmacopœia. The Pharmaceutical Society might also assist provincial societies in procuring complete sets of models illustrating the weights and measures of the metric system, so that any one might handle and become practically acquainted with them. It would be hopeless to expect that much could be done in a short space of time. What they wanted for the present was a plan calculated to familiarize educated men of business with the metric system.

Dr. Redwood read a letter from Mr. F. Lowe, of Liverpool, who advocated the octavial system.

Dr. Attfield considered there were immense advantages in a duodecimal over a decimal system, and an octavial was better than either, but as the world's system was a decimal one, ours should be so likewise.

Mr. Bottle, believing the system must ultimately be adopted, urged upon young men the necessity of making it an early study.

Mr. Haselden thought the system must be adopted some day, and looked to young men to make a study of it. He agreed with Mr. Carteighe in his proposal of an addition or supplement to the pharmacopœia. He would not like to see the metric equivalents added to the pharmacopœia itself, side by side with our own. He considered the adoption of the French weighing practice would be impeded by the aversion of the medical profession to making any change of the kind.

The Chairman saw no great difficulties in the way. Mr. Carteighe had referred to the fact that the Board of Examiners would require a familiarity with the metric system. He considered that the Society should procure a perfect set of weights and measures for their own museum previous to assisting provincial societies, as proposed by Mr. Carteighe.

Mr. Martindale thought there would be some difficulty in applying the system to dispensing, and in approximating metric weights and measures with the usual doses. He always found that medical students were taught the metric system in the laboratories at hospitals, and had subsequent difficulty in appreciating the value of grains, drachms, &c. He thought an octavial system was an impossibility.

Dr. Redwood thought the great defect of the present system was, that there were no integers between the grain and the ounce, and no relation between them. This had become so evident in compiling the pharmacopœia, that our present system could only be regarded as a temporary expediency. He confessed that he did not consider the metric system perfect, but he was somewhat surprised to hear he had been accustomed to condemn the system. A fault of the metric system was, that its integers had not been chosen because it was the best, but on theoretical ground; if our yard had been taken it would have been more convenient; our system is founded on experience, the metric on theory. The defects in our system must, however, be remedied, and the metric system seems to be the one generally adopted. We were the only advanced nation who had not adopted it; if we did so, it would soon become the international system. He (Dr. Redwood) thought that the difficulty would be in acquiring a knowledge of the value of its integers; to surmount this difficulty was the object of his proposals. Looking at a set of models in a museum would not suffice. He would like to have the weights marked on coin, the measures on postage stamps, &c., so as to associate the integers with objects with which we are familiar. He agreed with the proposal to enforce a knowledge of the system at the examinations, but he would only accede to the proposal to introduce weights and measures into the pharmacopœia on the condition that they were the exact equivalents. He would prefer a supplement.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of every chemical paper in the world *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers week by week on a level with the latest advances of science.*

Effect of Heat on the Electromotive Force of the Galvanic Battery.—M. Crova.—(*Cosmos.*)—The results obtained by the researches of this author are the following:—(1) The electromotive force of the Daniell's element decreases regularly with an increase of temperature; (2) the electromotive force of a Grove's element increases with the temperature; (3) the electromotive force of an element wherein only one liquid is applied (Smee's) is independent of the variations of temperature.

Action of Light upon Chloride of Silver.—(*Les Mondes.*)—When freshly precipitated chloride of silver (best obtained by means of decomposing a soluble silver salt with chlorine water) is placed in a white glass tube about 15 inches in length, and exposed to the action of direct sunlight, it will be observed that the chloride of silver remains quite white as long as the solution of chlorine water retains its greenish yellow colour; but as soon as that colour has vanished, the chloride of silver begins to decompose water under the influence of the direct rays of sunlight; the chloride gradually blackens, and after a shorter or longer duration of time, the whole quantity will have become black, especially if care be taken to shake the tube now and then, so as to expose the whole mass to the light. When the tube is afterwards placed in a dark place entirely excluded from daylight, the black colour of the chloride of silver again disappears gradually, and the chloride becomes white; this experiment can be repeated over and over again with the same tube. The bromide, and probably also the cyanide of silver, behave in

the same manner; the iodide of silver blackens only after having been rendered sensitive to light by pyrogallic acid.

Action of Sunlight on Glass.—M. Graffield.—(*Cosmos.*)—It is a well-known fact that, even independently from the effects of rain and wind, glass, even of good quality, is affected by sunlight. The late Dr. Faraday made some observations concerning this subject, and found that violet-coloured glass became deeper and more intensely coloured than it originally was after having been exposed to direct sunlight for eight months. M. Graffield, of Boston, U. S., who has been for more than twenty years in the wholesale glass trade, and is at the same time a good observer, has recently sent to the Photographic Society of Marseilles a series of the results of his researches and observations on this subject, in which he comes to the conclusion (which is especially important to photographers) that glass is even sensibly affected after one single day's exposure to the sun's rays, and that all glass, without exception, including that used for optical purposes, is more or less acted upon, even when made from the best materials and by most experienced workmen; greenish glass seems to become the least affected. The author has sent to Marseilles a series of photographs representing the tinge and changes produced in divers varieties and kinds of glass after exposing them to sunlight.

Adulterated Soap.—(*Les Mondes.*)—It appears that in consequence of some complaints concerning the soap supplied at the thermal establishment at Amélie les Bains, this soap was analysed. Its colour was greyish; odour very disagreeable (especially when recently cut); to the touch it was peculiarly greasy, causing a biting sensation at the same time. It was readily soluble in distilled water, producing a good lather, but the solution produced a biting pain when brought into contact with the hands. In 100 parts, the soap contained 29 of alkali and 19 of tallow; no wonder, therefore, of its effects on the skin, and complaints in consequence thereof.

Oxyhydrogen Light—Reduction of Earthy Metals.—The learned Abbé Moigno, while referring to this subject in *Les Mondes*, says, our readers will undoubtedly learn with pleasure that the production of oxygen in cheap manner from manganate of potassa and of pure hydrogen, by means of a hydrocarbon fuel (*combustible hydrocarboné*), on the large scale, has become a decided success; that, moreover, the reduction of the earths baryta, magnesia, and alumina to the metals barium, magnesium, and aluminium, by means of hydrogen under high pressure and a very high temperature, is successfully carried out; while, lastly, M. Caron has succeeded in obtaining, by means of great perseverance, zircon-magnesia cones, which, instead of being very breakable and only lasting for a few nights, are fit for use for any length of time.

Brittleness of Bones.—(*Les Mondes.*)—Professor Hofmann, at Prague, has recently analysed bones of cattle, some of which were derived from healthy animals, others, again, from animals which during life had been affected with fracture of bones consequent upon their great brittleness; while the composition of the former was normal, that of the latter proved to be abnormal, by containing a far greater proportion of carbonates and phosphates of lime and magnesia, while, at the same time, the nitrogen contained in the organic matter of the bone was considerably less than it should be; hence the Professor advised that, as a remedy in such cases, food richer in nitrogenous substances should be administered to the cattle.

Platinising Copper, Yellow Metal, and Brass.—(*Les Mondes.*)—In order to obtain the platinising fluid, add, to a moderately concentrated solution of chloride of platinum, finely-powdered carbonate of soda until effervescence ceases, next some glucose, and afterwards just so much common salt as will cause a whitish-coloured precipitate. When it is desired to apply this mixture for platinising, the objects to be treated are placed in a vessel made of zinc and perforated with holes; the vessel is then placed, with its contents, for a few seconds into the mixture just described, which, just previous to using, should be heated to 60° C. On being removed from the zinc vessel, the objects are to be washed with water and dried in sawdust.

Researches on Materials fit for Resisting very High Temperatures.—M. Audouin.—(*Cosmos.*)—While engaged with other studies on geology in the southern parts of France, the author found that between Tarascon and Antibes there exists a very valuable and extensive bed of *bauxite* (hydrate of alumina), which is occasionally applied for the manufacture of sulphate of alumina. This material has been applied, at the suggestion of Audouin, for the manufacture of crucibles and fire-bricks; and on having been tested in comparison with the best products of the kind from France, England, and Germany, it was found that even best fire-bricks might be melted in bauxite-made crucibles heated by mineral oils and a blast.

Synthesis of Paramonochlorobenzoic Acid.—(*Zeitschr. f. Chem. v. Beilstein.*)—Carl Müller has instituted, in the laboratory of Dr. Carius, at Marburg University, some researches on this substance. He found that paramonochlorobenzoic acid originates when chloride of benzol, C_6H_5Cl, is oxidised by the action of moderately dilute sulphuric acid and peroxide of manganese; a number of other products are simultaneously formed—among these, chiefly, formic acid. Paramonochlorobenzoic acid is a solid substance, fusible at 235° C., readily soluble in alcohol and ether, but difficultly so in water; one part of the acid requires 5288 parts of water for solution. The acid crystallises both by sublimation and from its alcoholic solution; the composition of its baryta salt is—

$$C_{14}H_8Ba''Cl_2O_4 + (OH_2)_4.$$

Its formation from chloride of benzol may be expressed by—

$$C_6H_5Cl + CH_2O_2 + O = OH_2 + C_6H_4Cl,CO,HO.$$

On the Solubility of Difficultly-Soluble Compounds in Aqueous Solutions of Sugar.—(*Zeitschr. f. Chem. v. Beilstein.*)—Dr. Jacobsthal has instituted a series of experiments on this subject, in order to ascertain the presence of various salts and their bearing upon the manufacture of beet-root sugar. The author experimented with the sulphate, carbonate, oxalate, citrate, and basic phosphate of lime, and the carbonate of magnesia; quantities of these salts in excess were placed in solutions of pure sugar in distilled water, containing respectively 5, 10, 15, 20, and 30 per cent of sugar. The salts were placed in flasks, heated for awhile on a water-bath, and left standing for from four to five days, care being taken to replace any water which might have evaporated, and also to shake the flasks daily for some time; the solutions were then filtered, and in the clear filtrate the quantity of salt dissolved was determined. The results obtained are exhibited in a tabular form, which represents—(1) the quantity of the various salts is dissolved in 1000 c. c. of the different sugar solutions; (2) the quantity of the salts which would have dissolved in the water present in the various sugar solutions, deducting the quantity of water required to keep the sugar respectively therein contained dissolved. It appears that the more a sugar solution is concentrated, the less it is capable of dissolving the salts experimented upon; the carbonate of magnesia is the only salt which makes an exception upon this rule; the results agree with some observations made by Cunze, who witnessed the separation of oxalate of lime from a sugar solution on becoming concentrated from 5 to 30 per cent.

Adulteration of Sulphuric Acid.—(*Rev. Hebd. de Chim.*)—It appears that some Continental makers of this acid are in the habit of adding to ordinary chamber acid a sufficient quantity of some cheap acid sulphate, so as to bring the sulphuric acid, as far as hydrometrical tests are concerned, up to the desired degree of density. M. Fleischer, having cause to complain about the bad quality of indigo-carmine prepared with a certain sample of sulphuric acid, was induced to evaporate some of the acid, and on doing so discovered the formation of crystals of sulphate of soda. This

kind of adulteration, however readily detected, might cause in many dye and madder and garancine works very serious loss and great inconvenience, and is a gross fraud: the inducement is the saving of the cost of evaporation and apparatus connected therewith.

On the Constitution of Glucina.—(*Zeitschr. f. Chem. v. Beilstein.*)—Dr. G. Klatzo has written, at Dorpat University, an essay on this subject, and conducted a series of experiments with oxide of glucinum, and prepared a large number of salts and double salts of this base. He has made several analyses of sulphate of glucina, and calculated from the results thus obtained the percentage of oxygen contained in the glucina at 63·425 per cent, the atomic weight of BeO at 25·227, and the atomic weight of Be at 9·227. As general results of his researches, the author states—1st, that glucina is in every respect a base similar to magnesia, which it can displace without change of crystalline for mand quantity of water of crystallisation; 2nd, the sulphates of glucina, heated to 150° C., still retain one atom of water, which, as is equally the case with magnesia salts, can be displaced by sulphate of potassa; 3rd, like magnesia and oxide of zinc, glucina crystallises from its solution in excess of water saturated with carbonic acid, and yields a neutral crystalline carbonate, capable of forming, with the carbonates of the alkalies, perfectly crystallising double salts.

Journal für Praktische Chemie, 1869, No. 2.—This number contains the following original papers:—

Researches on some New Minerals.—M. R. Hermann, having the opportunity of sorting a parcel of minerals from Nishny-Tagilsk, Russia, found among these one which, in consequence of its outward similarity to copper lazurite, *kupferblau*, attracted his attention. On testing it qualitatively, however, he discovered that, unlike the mineral just named, the substance he had to deal with contained, besides silica, oxide of copper, and water, also a large quantity of phosphoric acid. The mineral was named by him *cyanochalcite;* it is a tough substance, its fracture is even, it is transparent at the edges, has a sky-blue colour, its hardness is 4·5, and its specific gravity 2·79; on being heated, it loses water and becomes black; before the blowpipe it gives the reactions of copper; is readily soluble in hydrochloric acid, does not effervesce with acids, while on becoming dissolved silica is separated in the shape of a powder; molybdate of ammonia added to its solution indicates phosphoric acid. Results of analysis gave, for 100 parts:—Silica, 26·90; phosphoric acid, 6·95; oxide of copper, 49·63; water, 16·52. The genuine copper lazurite contains 45·5 per cent of oxide of copper, but no phosphoric acid at all. Hydrargillite, from Chester county, U.S.:—Hardness, 3·0; specific gravity, 2·35; infusible before the blowpipe. Contains in 100 parts:—Phosphoric acid, 0·91; alumina, 63·84; water, 33·45; silica, 1·50; and traces of magnesia and peroxide of iron. Wavellite, from the same county, contained:—Phosphoric acid, 32·70; alumina, 35·83; water, 28·39; peroxide of iron, 3·08; and a trace of fluorine. The hardness of this mineral was 3·5; its specific gravity 2·30.

Acetonic Acid.—This acid is prepared in the following manner:—Aceton, hydrocyanic acid, and dilute hydrochloric acid are mixed, and then left standing together for three weeks; after this time the mixture is boiled on a water-bath for three days in a retort or flask with a condenser attached to it, and so arranged as to admit of the reflux into the retort of the greater part of the condensed liquid; the residue is then treated with ether. After evaporation thereof, a sour yellow extract-like substance is obtained, which contains acetonic, formic, hydrochloric acid, and still a little hydrocyanic acid; this mass is again concentrated by evaporation, then diluted with water, boiled, and while boiling neutralised with carbonate of zinc. After filtration the filtrate yielded acetonate of zinc; this was diffused through water, and the zinc removed by sulphuretted hydrogen, the sulphide of zinc having been separated by filtration, the acid after a time was obtained in solid crystals by slow evaporation. It is a solid, very readily soluble in water, alcohol, and ether; it sublimes when quite dry, and fuses at 79° C. The acetonate of zinc is a difficultly soluble salt, which contains 24·59 per cent of zinc.

On a Constituent of the Resin from the Ferreira Spectabilis.—It appears that in the Brazils there is in use, as a febrifuge, a resin, known in some parts of the country as *sulphato*, in others as *Resina d'angelim pedra*. When this resin is first digested with water, which removes colouring matter, the residue dissolved in water acidulated with hydrochloric acid, and the crystals thereby obtained first purified with water, next with absolute alcohol, again dissolved in hot water, and this solution treated with ammonia, a substance is precipitated which has been named *angelin;* this material had been sent from Cantagallo to Vienna, and was thence forwarded to Prague, to Dr. Gintl, for examination and report. That gentleman, after very exhaustive qualitative and quantitative researches, found, on elementary analysis of the frequently purified substance, that it consists, in 100 parts, of:—C, 61·51; H, 6·81; N, 7·26; O, 24·42; formula—

$$C_{10}H_{13}NO_3.$$

Dr. Gintl further found that angelin is in all respects identical with Ruge's ratanhin, also in its behaviour with nitric acid, by which both these substances are first made rose, next ruby-red, and finally deep violet coloured, provided only dilute acid be applied, and heated very gradually and gently.

On a Combination of Hydrate of Phenyl and Carbonic Acid.—M. Barth caused some porous substances to become inpregnated with the hydrate of phenyl, and placed these in the iron vessel belonging to Natterer's apparatus for condensing carbonic acid; he then condensed some of that gas in the said vessel, and, on inspection after a few days, he found that the phenyl-alcohol had been converted into a mass of crystals very like those which the cubes of common salt form when agglutinated together. Barth found that these crystals contained carbonic acid, and a series of quantitative experiments proved the quantity of that gas to be from 5 to 5·5 per cent; the crystals fused at 27° C. on exposure to air, and very frequently were forced asunder with a sharp report; when one breathed over these crystals, they became covered with a slight foam. The compound is represented by the formula—

$$8C_6H_6O + CO_2.$$

Bulletin Mensuel de la Société Chimique de Paris, March, 1869.—This number contains the following original articles:—

Researches on the Milky Juice of the Antiaris Toxicaria.—Dr. De Vry and M. E. Ludwig have made researches on this substance, the produce of a tree which grows wild in Java, the juice of which, here alluded to, is applied by the natives to poison arrows; the specific gravity of the juice is 1·06; on evaporation it leaves 37·9 per cent of a brown resin. This resin, treated with warm petroleum (boiling at 60°) and with absolute alcohol, leaves 47 per cent of substances insoluble in these fluids; the petroleum dissolves an amorphous, and also a crystallisable resin, some fatty matters, and caoutchouc. The alcoholic extract contains antiarine, an acid, and a saccharine substance, while the insoluble portion is albumen. The antiarine is a glucoside, which can be split up into sugar and a yellow resin; its composition in 100 parts is expressed by—C, 61·2; H, 8·1; O, 30·7. The crystallisable resin, differing from the resin antiar described now about forty years ago by Mulder, contains in 100 parts—C, 83·9; H, 11·9; O, 4·2.

On the Colouring Matters of the Anthracen Series.—MM. Graebe and Liebermann have found that when purpurine (extracted from madder root) is heated with powdered zinc, anthracen is obtained identical to that which alizarine yields when distilled with zinc. When purpurine is treated with reducing substances it yields, as also does

alizarine, a colourless substance, which oxidises in the air, and then yields again purpurine. From these and other reactions the authors infer that purpurine is oxyalizarine, or trioxyanthraquinone—

$$C_{14}H_5\left\{\begin{matrix}(HO)_3\\O_2''\end{matrix}\right.$$

Chrysophanic acid has been considered by Rochleder as represented by—

$$C_{10}H_8O_3,$$

while Gerhardt expressed its constitution by—

$$C_{14}H_{10}O_4;$$

this acid yields, with nitric acid, chrysammic acid, which, according to the authors of this paper, is tetranitroxyanthraquinone—

$$C_{14}H_2(NO_2)\left\{\begin{matrix}H_2O\\O_2''\end{matrix}\right.$$

Aloine, treated by powdered zinc, has also yielded anthracen; aloine yields chrysammic acid when treated with nitric acid. Gentianic acid—

$$C_{14}H_{10}O_5,$$

and euxanthone—

$$C_{20}H_{12}O_6,$$

have been likewise treated by zinc; these acids did not yield anthracen, but other hydrocarbons.

Iron in Milk.—M. Bistron has found that the milk of the female goat contains on an average 0·1 grm. of iron in 1,000 parts of milk; this quantity of the metal appears to be constantly present in that fluid, and corresponds with the quantity found in the milk of women.

On the Application of Alkaline Iodides as Reducing Agents.—M. Berthelot read a short paper on this subject at the meeting of the Paris Chemical Society, relating his experience in this respect, and stating that though iodide of potassium is in many instances more preferable to use than hydroiodic acid, it is less active than that substance. The same applies to iodide of ammonium; this is explained by the author to be caused by the greater stability possessed by these compounds.

On the Use of Protoxide of Thallium as an Ozonoscopic Substance.—M. Lamy communicated, at the meeting of the Society, the following observations made by him concerning this subject as the result of a series of experiments made during a year, not only in Paris, but in divers parts of France, including some remote mountainous districts:—(1) Protoxide of thallium assumes a brownish tinge, even when out of reach of any air or ozonised oxygen; (2) the sensitiveness of the thallium paper varies according to the degree of concentration of the solutions which have been applied in preparing it, or their more or less advanced state of carbonatation; (3) recently prepared thallium paper is more sensitive to ozone than paper prepared with starch and iodides; (4) the more or less dark colour of the thallium paper only, then, indicates ozone when that same paper afterwards renders tincture of guaiac blue when moistened with that fluid; (5) when this condition is properly attended to, protoxide of thallium paper is very fit to indicate rapidly and with certainty ozone, even in an atmosphere containing nitrous acid fumes; but this paper can only serve as a reagent for ozone, and is not fit for showing any quantity thereof in the atmosphere.

On the Action of Light upon Sulphide of Carbon.—Many of our readers have had the opportunity of noticing that the bottles, especially if made of white glass, containing sulphide of carbon often become lined, if exposed for any length of time to direct sunlight, with a coating strongly adhering to the glass. M. Loew has experimented on this substance, by enclosing the sulphide in sealed glass tubes previously moistened with water, which has the effect of lessening the adhesiveness of the brownish coating. On opening the sealed tubes after a few months' exposure to sunlight, the water was observed to have an acid reaction, due to the formation of some formic acid; the solid substance alluded to is insoluble in alcohol, chloroform, ether, and sulphide of carbon, but soluble in a boiling solution of caustic potassa, becoming, however, at the same time decomposed. The substance is sesquisulphide of carbon, which, on being submitted to distillation, is decomposed, yielding sulphur and carbon; the sulphide of carbon from which this substance is deposited contains sulphur in solution, though perfectly pure previous to exposure to sunlight.

Estimation of Suboxide of Copper occurring in Metallic Copper, and especially in the Variety of this Metal known as Rosette.—When dilute sulphuric acid acts upon suboxide of copper in the presence of nitrate of silver, the suboxide is split up into metallic copper and oxide of copper, which becomes dissolved as sulphate, while the metallic copper takes the place of the silver of the nitrate of that metal. In order to apply this reaction for analytical purposes, M. C. Aubel takes 0·5 gramme of the copper to be tested, previously reduced, by proper mechanical means, to powder or filings; he adds 1·3 grm. of solid nitrate of silver mixed in a mortar with 10 c.c. of dilute sulphuric acid. The decomposition sets in at once, and is entirely complete after two hours' time; water is then added, the metallic silver is collected on a filter, well washed, and, after having been dried, is weighed.

Volumetrical Estimation of Chromic Acid.—M. C. Zulkowsky adds to the chromic acid solution a sufficient quantity of iodide of potassium, free from iodate, and pure hydrochloric acid. This mixture is left quietly standing for from half an hour to a few hours' time, according to the degree of concentration of the solution, for in no case is the reduction of the chromic acid by means of the hydriodic acid instantaneously effected. When the reduction is complete, which may be learned from the pure green colour the liquid has assumed, a small quantity of thin starch paste is added, and the quantity of iodine which has been set at liberty is estimated by titration with a solution of hyposulphite of soda. Quantitative test solutions are prepared by dissolving 24·8 grms. of hyposulphite of soda in a litre of water, and 4·9196 grms. of bichromate of potassa also in a litre of water; by this arrangement 1 c.c. of the first solution is equal to 1 c.c. of the chromate solution containing exactly 0·003349 grm. of chromic acid.

Testing Sulphate of Quinine.—M. Panot applies, for the purpose of ascertaining the presence of salicine in sulphate of quinine, the well-known action of oxidising substances upon salicine, and the transformation of the hydride of salicyl into a substance which, under the influence of perchloride of iron, assumes a bluish violet colour. The suspected sulphate of quinine is placed in a flask, to which, by means of a perforated cork, a glass tube can be fixed; then 2 c.c. of dilute sulphuric acid (1 of acid upon 4 of water), and 4 c.c. of a saturated solution of bichromate of potassa, are poured into the flask; heat is applied to the flask, and its contents brought to boiling, while the products of the distillation carried off by the glass tube are collected in distilled water. When the reaction ceases, some few drops of a solution of chloride of iron are added to this distilled water, and, should a violet colouration ensue, this will be evidence of the adulteration with salicine of the sulphate of quinine; the presence even of ½ per cent of salicine is very readily proved by this process.

On the Characteristic Differences and Tests for the Detection of some Fatty Oils.—Dr. Sacc, of Neufchâtel (*Rev. Hebd. d. Chim.*, No. 22, 1869.)—Although the fatty oils are nearly all compounds of fatty acids and glycerine, there exists among them so much difference of physical properties that there is good cause to assume that the diversity of taste and the colour and odour exhibited by these oils is due to very slight differences in chemical characters, and hence behaviour with reagents, which the author has endeavoured to find out, and thereby render the detection

of adulteration a more easy matter. *Olive oil.*—Colour light yellow, odour faint; heated to nearly its boiling point it decrepitates, in consequence of having retained slight traces of water, and becomes discoloured without further change. A mixture of equal bulks of oil and of nitric acid of 1·31 sp. gr. at 55° F. does not at the ordinary temperature produce any change. Sulphuric acid of 1·76 sp. gr., and at 55° F., unites with the oil, the mixture becomes hot, dark coloured, and, on addition of cold water, the dark mass, while dissolving therein, becomes white. Commercial acetic acid has no action whatever upon the oil; caustic soda lye of 1·04 sp. gr. at 55°, produces, even in the cold, a white emulsion; alcohol of 90 per cent floats on the oil, but does not dissolve it. Ether, benzol, light petroleum, naphtha, sulphide of carbon, and spirits of turpentine dissolve the olive oil and all the following oils. A solution of nut-galls, of 100 grammes weight of galls to the litre of water, does not change olive oil when mixed therewith; this reaction enables us to distinguish between ground-nut and sesame oil, with both of which olive oil might be confused. Caustic ammonia readily forms a beautifully white emulsion with this oil, which is not at all acted upon by solutions of nitrate of silver and chloride of gold. *Colza oil.*—Golden yellow colour, faint odour, somewhat resembling that of turnips; when heated to boiling point its colour becomes lighter. Nitric and acetic acids do not act upon this oil; sulphuric acid, when mixed with this oil, evolves much heat, while a dark-brownish mass is formed, which, on being dissolved in water, becomes white; caustic soda solution and liquid ammonia form emulsions with colza oil, which is insoluble in strong alcohol and specifically heavier than that fluid. Solution of nut-galls forms an emulsion, and the same is also the case with chloride of gold and the oil; nitrate of silver causes a turbidity in the oil, and appears to become partly reduced to metal. *Oil from Arachis hypogœa: Ground nut oil.*—Light straw-yellow colour; odour faint; no change when heated to boiling point, and becomes turbid and more dark-yellow coloured on addition of nitric acid; addition of sulphuric acid evolves much heat and changes it, as did the same acid when added to colza oil; with soda solution and with solution of nut-galls the same behaviour as the foregoing, ammonia also as the foregoing, and alcohol the same; no action with nitrate of silver, while chloride of gold forms an emulsion with this oil, and becomes partly reduced to the metallic state, perceptible by a violet colouration. *Nut oil.*—Bright lemon yellow; odour acrid; heated, it boils quietly, and its colour becomes less deep; is rose-coloured by nitric acid, but the colour disappears very rapidly, and a slight turbidity is produced; with sulphuric acid a great heat is developed, and the oil obtains a cinnamon-brown colour; the mixture swells upon being placed in water, becomes white, and a portion of oil which had not been apparently acted upon floats on the top of the water. Acetic acid, soda solution, and solution of nut-galls do not act upon this oil at all; alcohol does not dissolve it and floats on it; nitrate of silver causes a slight turbidity, while chloride of gold is readily reduced by the oil. *Whale oil.*—Dark yellow coloured; odour very disagreeable and nauseous; on being heated, the oil boils readily and without spurting; nitric acid produces a bister colouration; sulphuric acid develops very little heat, and causes a cinnamon-brown colouration. When the mixture of this acid and oil are placed in water it becomes white and disengages an odour somewhat resembling that of asphalt. Acetic acid and solution of nut-galls are without action upon this oil; with soda solution a yellow emulsion is formed; alcohol does not dissolve it; liquid ammonia forms a yellow emulsion; nitrate of silver, no action; chloride of gold, traces of reduction. All the reactions before mentioned have been made with equal bulks of oils and reagents in test-tubes at a temperature of from 15° to 20° C., and the substances have been left in contact for thirty-four hours; this also applies to the following experiments:—*Cotton seed oil* (of course refined).—Bright orange yellow colour, faint odour, no change on being boiled; becomes brown at the points of contact when treated with nitric acid. Sulphuric acid causes evolution of much heat, changes it into a brown mass, which, on being placed in water, becomes white and dissolves therein; acetic acid and nitrate of silver have no action upon this oil; solution of soda and liquid ammonia form emulsions with difficulty with the oil, which is itself insoluble in alcohol; solution of nut-galls causes an emulsion, as does also a solution of chloride of gold, which is, moreover, perceptibly reduced to the metallic state. *Sesame-seed oil.*—Colour bright yellow; odour faint; becomes nearly colourless when heated to boiling point. With nitric acid, bright orange colour; with sulphuric acid, evolution of heat, dark brown colour, and, on addition of water, violet colour, and soluble therein (it should be observed that sulphuric acid really saponifies most of these oils, and that the soap so formed is soluble in water added in excess); acetic acid, no action; with soda, ammonia, and nut-gall solutions, emulsions are formed, all of which exhibit a white colour; not soluble in alcohol, and thickens on addition of nitrate of silver. Chloride of gold causes formation of an emulsion, and is itself perceptibly reduced to the metallic state.

Annalen der Chemie und Pharmacie, April, 1869.

The following are the original papers which appear in this number:—

"*On Salicyl Compounds*," by Schröder and Prinzhorn.—"*On Propylphycite and some Substances allied thereto*," by J. G. Wolff.—"*On a New Method of the Formation of Glycogollamide, and on the Constitution of Urea.*" by Heintz.—Second part of lengthy treatise of A. Liceben's "*On the Synthesis of Alcohols by Means of Chloruretted Ether.*"—Reply from A. Strecker to M. Maly's criticisms on Strecker's paper "*On the Identity of the so-called Abietinic Acid and Sylvinic Acid.*"

The above papers are treatises and essays rather than papers, and are so concisely written as to be unfit for condensation.

Moniteur Scientifique, No. 297, 1869.

The Use of Bran in Brewing, Manufacture of Spirits and Starch Making.—Since bran contains from 40 to 60 per cent of its weight of starch (farine), M. Poncelet proposes to use a certain quantity of bran instead of malt or raw grain for the purposes of brewing, making spirits from grain, and the manufacture of starch. He either uses the bran as it is, or extracts the starch from it previously, and adds this substance to the materials required for the mash-tubs.

The Substitution of Alum-shale for Bone-Black in Sugar Manufacture.—M. Belin proposes to do away with the use of animal charcoal for sugar manufacturing purposes, and to substitute instead the exhausted alum-shale after it has been applied to the manufacture of alum, or sulphate of iron. 100 parts of juice from beet-root require from one to eight parts of the exhausted shale. The liquid, after having become clarified, is evaporated to 26 degrees Beaumé in contact with air without any previous filtration, and next concentrated in vacuum pans to 43 degrees. The concentrated syrup thus obtained is run into large iron tanks and left to crystallise. The only advantage gained by this process is, beside the saving of animal charcoal, the obtaining of molasses better fit for the distillery of spirits usually connected with beet-root sugar works.

Sulphurous Acid for Dissolving Bones.—It is well known that hydrochloric acid is used for the purposes of dissolving the earthy salts of bones, in order to obtain the gelatine they contain in such a state as to render that substance readily soluble in boiling water. The use, however, of hydrochloric acid is rendered rather inconvenient for this purpose, on account of the formation of chloride of calcium which interferes with the drying of the gelatine. M. Coignet, at Paris, has found that sulphurous acid answers the purpose of hydrochloric acid in this instance perfectly well.

[English Edition, Vol. XIX., No. 493, page 238; No. 494, page 249.]

The bones are placed in cold water, and through the water a current of sulphurous acid gas is forced so long as is required to completely soften the bones, which are afterwards washed in fresh water wherein some sulphurous acid gas has been previously dissolved.

Les Mondes, May 6, 1869.

Oxyhydrogen Light.—The following description is given of the experiments which are every evening made at 44, Rue Lafitte, Paris, with the above-named light:—The burner, which is arranged to burn either pure hydrogen gas or coal gas at any pressure from 2 millimetres up to several centimetres, is constructed in the following manner:—The oxygen issues from a central opening, the hydrogen or coal gas issues from small tubular openings, not unlike those met with in the Leslie gas-burner; but instead of being as in that burner almost vertical, they are in this instance bent so as to lay almost horizontal, and thus stand with the openings opposite to each other, while the oxygen is in the centre; the flame is directed against a piece of zircon-magnesia. We further notice a circular Argand burner without any magnesia cone, and so arranged as to have the combustion of the gas supported by oxygen gas instead of by air. A modification of this burner, as regards the arrangement of the supply tubes, is made to serve for burning gas fed by oxygen, the burner being placed in strong glass globes so as to suit the purposes of lighting mines and for submarine lamps. Care has been taken by proper and suitable means to carry off the products of the combustion in each case in such manner as to insure the safe use of the apparatus.

Bulletin Mensuel de la Société Chimique de Paris, No. 4, 1869.

This number contains the following original papers:—

Discovery of a New Base.—M. Wurtz has succeeded in obtaining a new base by making chlorhydrate of glycol act upon toluidine at a temperature of from 200° to 220° C. This substance exhibits a beautifully green fluorescence, has a bitter taste, is precipitated by a solution of iodine in solution of iodide of potassium. It contains H_2 less than toluidine, while for two other hydrogen atoms are substituted a vinyl and hydroxethylen group. The chloroplatinate of the base is a crystalline substance readily decomposed by heat.

Two replies, rather than papers, by Messrs. Fittig and Wurtz, to criticisms made upon their work are of no particular interest. Concluding portion of Berthelot's paper "*On the Universal Method of Reducing the Hydrogen of Organic Compounds.*" "*On the Detection of Sulphur by the Spectroscope*," by M. Salet. This is a re-discovery of Mr. Barrett's researches on this subject published some years ago in the *Philosophical Magazine.*

On a Substance Homologous with Borneo Camphor.—The substance known in perfumery and pharmacy as patchouli camphor is, according to recent researches of M. Gal, a substance homologous with Borneo camphor, which is represented by $C_{30}H_{28}O_2$. The average results of several elementary analyses of patchouli camphor gave for 100 parts:—C, 80·1: H, 12·6; the formula just quotod requires C, 80·3: H, 12·5; the vapour density of this substance taken at 324° is 8·00; patchouli camphor is solid, fuses between 54° and 55°, and boils at 296°; its specific gravity is 1·051, at a temperature of 4·5° C. The camphor is insoluble in water, readily soluble in alcohol and ether; it crystallises in hexagonal prisms. While Borneo camphor is a right-handed rotatory substance, the patchouli camphor is left-handed. When patchouli camphor is distilled with chloride of zinc at between 248° and 252° C., it yields a carbide of hydrogen, $C_{30}H_{26}$. The essence of patchouli is isomeric with the camphor, which is, it appears, simply formed by a molecular change.

On the Acetone of Formic Acid.—M. E. Mulder instituted the following experiment in order to prove that methylic aldehyde and aceton are identical, and must be both expressed by the formula, H,CO,H_2. The author has submitted formiate of lime to distillation, and has obtained a liquid which reduces silver salts to metal readily, and is, moreover, possessed of all the properties of Hofmann's methylic aldehyde.

On Nitroglycerine.—M. Tilberg has made some researches on this substance, making use of the nitroglycerine manufactured on the large scale at Stockholm. This material is decomposed by potassa, giving rise to the formation of nitrate of potassa and glycerine; but, at the same time, there are formed secondary products, as ammonia, cyanogen, oxalic and ulmic acids, and nitrous acid. According to the results of elementary analysis made by the author, the formula for this kind of nitroglycerine should be $C_3H_5(N_3O_2)O_3$. The substance is soluble in concentrated sulphuric acid, yielding a clear solution, and forming a sulphoconjugate which, on being combined with bases, gives crystallisable salts.

On some New Combinations of Orcine.—M. V. de Luynes observed that orcine combines directly with picric acid, when that acid is mixed with water in too small a quantity to admit of its solution. On raising to the boiling point, orcine is added gradually until all the picric acid has disappeared. On cooling, crystals are deposited which have the appearance and colour of bichromate of potassa. These crystals are deliquescent, soluble in water, alcohol, and ether, and decomposed by benzol, which takes up the picric acid and leaves the orcine. They are represented by the formula—

$$C_{12}H_8(NO_4)_3O_2,\ C_{14}H_8O_4 = C_{26}H_{11}N_3O_{18}.$$

Orcine combines directly with nicotine, forming a rose-coloured solution. When previously fused orcine is placed under a bell-jar filled with gaseous oxide of ethylen, the gas is absorbed, and the orcine liquefied. An aqueous solution of orcine dissolves rosaniline, partaking of the colour exhibited by the solutions of that substance. It would appear that orcine also combines with common salt.

A New Compound of Lime and Sugar.—Messrs. Boivin and Loiseau have formed a new combination of lime and sugar which, moreover, contains carbonic acid. It is prepared in the following manner:—To 200 kilos. of syrup containing 60 per cent of crystallisable sugar, 120 kilos. of caustic lime as a thickish milk of lime are added, and next carbonic acid gas is passed through the mixture. After some time a precipitate is formed, and as soon as it makes its appearance, 20 litres of tepid lime water are added, and the stream of carbonic acid gas is stopped. The precipitate just alluded to is the new compound, and it contains in 100 parts, 43 of sugar, 40 of lime, and 17 of carbonic acid.

Fluosilicic Acid for Sugar Refining.—It appears that M. Marix has taken in France a patent for the application of fluosilicic acid for the purifying of beet-root and other saccharine juices. The saccharine fluids are first diluted with a sufficient quantity of water to take away the viscosity of these fluids, sufficient fluosilicic acid is then added to precipitate all the potassa salts present, and next powdered chalk is added to saturate any excess of the acid. The fluid is then filtered in order to obtain a clear liquid, and this afterwards treated in the usual manner.

Bleaching Paper Pulp.—M. Gauny proposes to bleach paper pulp by means of bichromate of potassa. For 100 kilos. of pulp (supposed to be dry) he uses 50 kilos. of bichromate and 150 kilos. of hydrochloric acid, mixed with a sufficient quantity of water to make the pulp float. After twelve hours' standing, the chloride of chromium is washed out by means of clean water, and the pulp treated with a small quantity of bleaching powder to make it thoroughly white. The chloride of chromium is precipitated by means of excess of lime, and this mixture is calcined in a reverberatory furnace, where it is converted into chromate of calcium.

Many of the papers and short notices in this periodical appeared some years ago in the Chemical News. Some are eleven years old.

Journal für Praktische Chemie, No. 3, 1869.

This number contains the following original articles:—

Extraction of Zinc from its Ores by the Wet Way.—It appears that, in consequence of the scarcity of fuel, and the poverty of the main bulk of the zinc ores now found in Silesia, Prussian Empire, M. O. Jungkann has been making experiments to try to find a method of extracting from the ore there found the zinc it contains in a quantity of from 7 to 10 per cent, by the so-called moist way; the ore is calamine stone, or carbonate of zinc mixed with impurities, as oxide of iron, sand, alumina, lime, and magnesia. Liquid ammonia, chloride of ammonium, and hydrochloric acid were tried, but did not, for various and local reasons, answer the purpose. The author next tried chloride of calcium; this he found to answer as well with the soft residue of washing the ore schlich, containing only from 4 to 10 per cent of zinc, as with lumps containing from 20 to 27 per cent thereof; the result is that a nearly concentrated solution of chloride of calcium and boiling heat are required, but then the extraction is complete and far less expensive than with fuel, and the material obtained is readily reduced by the ordinary method of zinc smelting.

On Oxysulphobenzid.—Dr. L. Glutz has made a series of experiments which induce him to call phenol not an oxyhydrate, but an oxyhydrocarbon; this opinion is based upon the change which phenol undergoes when it is converted into oxysulphobenzid. This substance—

$$\left.\begin{matrix}C_{12}H_5O_2\\C_{12}H_5O_2\end{matrix}\right\}S_2O_4$$

is obtained when 1 equivalent of phenol is heated to 160° C. with $1\frac{1}{2}$ equivalents of strong sulphuric acid, the mixture poured into water, wherewith the crystalline mass thus obtained is thoroughly washed; it is next purified by dissolving it in ammonia, and precipitated from this solution by means of hydrochloric acid. The oxysulphobenzid is almost insoluble in cold water, readily soluble in alcohol and ether; it crystallises from its solution in boiling water, forming needle-like crystals; it is not affected by a high temperature, but it is difficultly sublimed; on being heated to redness it first melts, next burns off, leaving a difficultly combustible coal. It is a weak acid, and readily soluble in the alkalies and their carbonates; it combines as well with acids, and very readily with nitric and acetic acids, but these compounds can only be formed indirectly. The author considers this substance to be an oxyaceton of the sulphuric acid series—that is to say, a derivative of a bibasic sulphuric acid, the extra radical oxygen atoms of which have been replaced by oxyphenyl.

On Mercury Naphthyl.—MM. Otto and Möries have instituted some researches on this compound, which was obtained by treating bromonaphthalin, boiling at between 277° and 278° C., with coal-tar oil boiling at 120° to 140° C., with pasty sodium-amalgam; heat was applied, and the mixture brought to boiling and filtered while hot; on cooling, the filtrate deposited the mercury-naphthyl in small yellow crystals, which were purified by repeated re-crystallisation from solutions in benzol or sulphide of carbon. The mercury-naphthyl—

$$\left.\begin{matrix}C_{10}H_7\\C_{10}H_7\end{matrix}\right\}Hg$$

exhibits small colourless prismatic crystals, not changed in the air or light, without smell, insoluble in water, sparingly soluble in alcohol, more readily soluble in warm benzol, sulphide of carbon, and best in chloroform; it fuses at 243° C., and is not quite volatile without becoming simultaneously decomposed. Heated with soda-lime, it yields mercury, naphthalin, and a hydrocarbon melting at 133° C.; the haloid hydrogen acids decompose it into naphthalin and the respective haloid salts of mercury. When moistened with alcohol, sulphuretted hydrogen does not affect it at all; fuming nitric acid converts it into nitrate of mercury and a nitro-substitute of naphthalin. Dissolved in sulphide of carbon it combines with iodine, forming biniodide of mercury-naphthyl.

Zeitschrift für Chemie, von Beilstein, No. 5, 1869.

This journal contains the following original articles:—

On the Decomposition of Grape Sugar in Alkaline Solution by Oxide of Copper.—It is well known that some years ago it was stated by Reichardt that gum and gummic acid ($C_6H_8O_{10}$) were the products of this reaction. M. A. Claus has endeavoured to control this statement by making a new series of researches on this subject; he reduced about 80 grms. of oxide of copper (equal to 36 grms. of sugar) at a temperature between 12° and 14° C., filtered the liquid, acidified it with acetic acid, and precipitated with acetate of lead; the precipitate thus obtained was carefully washed, next decomposed by means of sulphuretted hydrogen, the sulphide of lead removed by filtration, and the fluid somewhat evaporated at a temperature not exceeding 40° C. After removal of the HS, the fluid was divided into two equal portions, one of which was precipitated with chloride of calcium, the other with chloride of barium; the precipitates thus obtained were, after having been dried at 100° C., perfectly white, but not crystalline. The salts were analysed, and the result was, that not gummic acid, but oxymalonic acid, is formed; but this acid is no more the chief produce of this reaction than is gummic acid. The quantity of oxymalonic acid is only small; at the same time oxalic, formic, and acetic acids are generated. The quantity of oxymalonic acid obtained in free state was too small for full investigation of its properties.

Oxidation of Acetic into Oxalic Acid.—Dr. F. Lossen states that when one part of acetate of soda, one part of hydrate of soda, and two parts of permanganate of potassa are dissolved in a little water, the solution concentrated by boiling, and next brought to dryness at a temperature at which oxalic acid is not decomposed, and this heating continued until a small test-portion ceases to yield, with water, a green-coloured solution, oxalic acid can be readily proved to exist in the remaining saline mass.

On the Constituents of Peru Balsam.—M. Delafontaine has recently taken up this subject again for his experimental researches. He obtained a substance known as cinnamein, which, however, appears to be a mixture of cinnamic-benzyl ether and cinnamate of cinnamic ether; this cinnamein boils at 305° C., but is then, also, partly decomposed, leaving a resinous residue, while, when the operation is pushed rather rapidly, inflammable gases are also given off. In order to prevent any secondary decomposition, a portion of cinnamein which had not been submitted to any heat at all was saponified in the cold with an alcoholic solution of caustic potassa, and the result of this operation treated with water; this dissolved cinnamate of potassa and an oil was set free, which, by means of fractional distillation, was separated into benzyl alcohol (boiling at 205°) and cinnamic alcohol (boiling at 222°); this latter was colourless, very fluid, and the quantity obtained thereof was about half that which was obtained of benzyl alcohol. The results of the researches made by Plantamour on this subject about thirty years ago were the same. The chief mass of the balsam is therefore cinnamein, but it also contains variable quantities of other substances, among these toluol and some ethereal oils not properly known in separate state.

On the Estimation of the Value of Indigo.—M. George Leuchs estimates the indigo-blue, the chief and only valuable constituent of the drug, in the following manner:—By means of 35 grms. of lime and 30 grms. of protosulphate of iron, 10 grms. of indigo are dissolved in 3 litres of water. In order to exclude the access of air, some petroleum was poured on the top of the fluid; (this fluid, however, was simply used as one to experiment with), and the experiments lead to the result that equal portions of this solution reduce equal quantities of peroxide of iron, and that this reaction proceeds as expressed by—

$$C_{16}H_6NO_2+Fe_2O_3=2FeO+C_{16}H_6NO_2+HO.$$

In order to test any sample of indigo, 1·31 grms. thereof are so mixed with lime and sulphate of iron as to form a solu-

tion measuring 300 c.c., which should be placed in a tall cylindrical glass vessel provided with a well-fitting glass stopper. To 100 c.c. of the solution thus obtained, 66⅔ c c. of a solution containing 1-10th of iron alum acidulated with sulphuric acid are added; the fluid so obtained is filtered, and 100 c.c. of the filtrate are taken and titrated with a solution containing 1-10th of bichromate of potassa, which is best run into the indigo containing fluid from a burette having divisions of ½ c.c., in which case every division is equal to 1 per cent of indigo-blue.

No. 6, 1869.

On Cyanphenylen.—M. W. Irelan states that, when bromophenylsulphate of potassa and cyanide of potassium are intimately mixed, and after having been placed in a glass retort submitted to destructive distillation, a white substance is sublimed at the neck of the retort. It is a compound expressed by the formula $C_6H_4N_2$; it is, in fact, cyanphenylen, a substance possessed of a pleasant aromatic odour, insoluble in warm, as well as in cold water, difficultly soluble in boiling alcohol, and pretty readily sublimed by application of heat. Boiled with strong caustic potassa, it evolves ammonia, and is changed into an acid which, by its properties and composition, is terephthalic acid.

On Ethyldiphenol.—M. Burr states that when one atom of ethylenbromide, and two atoms of finely powdered phenolide of potassium, are heated together in a sealed tube at 140° C., bromide of potassium is formed, and an oily substance, which, on being first treated with water to separate it from the salt just alluded to, is readily soluble in ether, and, on the evaporation of that fluid having taken place, is left as a solid crystalline substance. Its formula is $C_{14}H_{14}O_2$; it is devoid of taste and smell, insoluble in water, soluble to some extent in alcohol, very readily and largely soluble in ether, fuses at 98·5° C., and becomes solid again at 92·5° C. On being heated on platinum foil it takes fire and burns off, giving a strongly sooty flame; on being heated with nitric acid, it is converted into a deep yellow mass of needle-like crystals, which is soluble in ether, and exhibits acid properties.

On Chlorethyl-sulphuric Acid from Chlorethyl-Chloride.—M. Kind has made some experiments with the view to ascertain whether the simply-chloruretted chloride of ethyl behaves with neutral sulphite of soda in a similar manner as ethylen chloride. Pure chloruretted chloride of ethyl, the boiling point of which was ascertained to remain constantly 63° C., was so mixed with sulphite of soda as to agree with two atoms of the latter substance against one of the former; the mixture was heated in a sealed tube for twenty-four hours consecutively at a temperature of 140° C. On opening the tube it was found that all the oily fluid had disappeared. The saline mass was first treated with dilute sulphuric acid until chlorine could not be any more detected by means of nitrate of silver, next neutralised with carbonate of soda, and, after having been evaporated to dryness, treated with alcohol; the therein soluble salt proved, on analysis, to have the exact composition of chlorethyl-sulphate of soda.

On the Synthesis of Hydrocinnamic Acid.—The formation of hydrocinnamic acid from cinnamic acid, and the fact first observed by Erlenmeyer, that the first-named acid is converted into benzoic acid on becoming oxidised, authorise the opinion that the constitutional formula of hydrocinnamic acid is—

$$C_6H_6+CH_2—CH_2—COHO.$$

M. R. Fittig has found this to be a correct view, by discovering a new synthetical method of preparation of the hydrocinnamic acid from phenylethylchloride, a colourless liquid which boils at about 200° C. This substance was first converted into a cyanide, by means of treating the same with cyanide of potassium and alcohol; this cyanide was decomposed with caustic potassa, the residue first acidified with sulphuric acid, next shaken up with ether. On removing the ether by distillation a yellow coloured acid fluid was left, which, on being repeatedly treated with cold water, became solid; a calcium salt of this acid was made, and found to be readily soluble in hot water, from which solution it crystallised in colourless silky-looking needle-shaped crystals. On being submitted to elementary organic analysis, this calcium salt, after having been first thoroughly dried over sulphuric acid, was found to yield results corresponding to the formula—

$$(C_9H_9O_2)_2Ca+1\tfrac{1}{2}H_2O,$$

which is identical with the formula derived by M. Erlenmeyer, from his researches on hydrocinnamic acid obtained from cinnamic acid.

On the Identity of Dichlorbenzoic and Paradichlorbenzoic Acid.—Dichlorbenzoic acid is readily prepared by boiling benzoic acid with a solution of hypochlorite of lime; the crude dichlorbenzoic acid obtained is combined with baryta, and the resulting salt purified by repeated crystallisation. The acid crystallises from its aqueous solution in needle-shaped crystals, fuses at 201° C., and sublimes without decomposition. The barium salt—

$$Ba(C_7H_3Cl_2O_2)_2+4H_2O,$$

crystallises in small needle-like crystals; the calcium salt—

$$Ca(C_7H_3Cl_2O_2)_2+3H_2O,$$

also appears to crystallise, and is more readily soluble in water than the baryta salt. From what has been communicated, it is clear that dichlorbenzoic and paradichlorbenzoic acid are one and the same substance.

On the Preparation of Methyl-naphthalin.—Methyl-naphthalin is prepared, according to Stacewicz, by heating together a mixture of a sulpho-salt of naphthalin, acetate of lime, and quick-lime. The distillate is dissolved in alcohol, and to the concentrated solution thus obtained water is gradually added; the substance thus separated is again dissolved in alcohol. After the evaporation of that menstruum a crystalline solid is obtained, somewhat yellow coloured, smelling like turpentine; it is sparingly soluble in alcohol, more readily in ether; is soluble in strong sulphuric acid, yielding to it a pink colour. Its specific gravity is about 1·0; it melts at 69° C.; formula, $C_{11}H_{10}$; percentage composition, C, 93·0; H, 7·0.

On Perchloride of Benzol and its Formation from Toluol and Xylol.—MM Beilstein and Kuhlberg have instituted a series of researches in order to prove that heptachlortoluol is nothing else than perchloride of benzol. The former substance has its formula C_7HCl_7, and its composition in 100 parts is expressed by—C, 25·2; Cl, 74·5; H, 0·3. The latter substance is expressed by the formula C_6Cl_6, and in 100 parts it contains—C, 25·3; Cl, 74·7. Elementary analysis could not decide anything in this instance, but the authors having followed Hugo Müller's method for the preparation of perchloride of benzol, and by diligently making a comparative study of the melting points, boiling points, and degrees of solubility, found that these properties so perfectly agreed that they feel confident both substances are identical.

On some new Compounds Derived from Mesitylen.—MM. Fittig and Hoogewerff have made a series of researches on this subject. Chlorine, it appears, acts most violently on mesitylen even when kept cold, so that the authors found great difficulty in managing the effects of this gas. They obtained monochlormesitylen, $C_6H_2Cl(CH_3)_3$, a colourless fluid as limpid as water, which boils, without undergoing decomposition, at between 204° and 206° C.; it is readily soluble in alcohol. Dichlormesitylen, $C_6HCl_2(CH_3)_3$, is a solid; it crystallises from alcohol, forming beautifully shining prisms, fuses at 59° C., boils without decomposition at 243°, is readily soluble in warm alcohol, and, in the cold, in ether and benzol. Trichlormesitylen, $C_6Cl_3(CH_3)_3$; this substance is also a solid, and obtained when mesitylen, kept very cold, is treated with an excess of chlorine gas; it crystallises from boiling alcohol, yielding long colourless

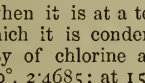
needle-shaped crystals, not very soluble in cold alcohol, better in ether; fusing, without decomposition, at 204°; sublimable, also, without decomposition, at a higher temperature. The authors have studied and extended their researches over a series of very complex compounds obtained by the action of nitric acid upon the monochlormesitylen, and also over the derivatives from sulphomesitylenate of potassium; but, for particulars about these compounds, we beg to refer our readers to the original paper, since the authors have so concisely exposed these researches, that it is quite impossible, in justice to them and the subject, to abstract these matters.

On the Specific Gravity of Chlorine.—M. E. Ludwig observes that, as a consequence of a series of determinations of the specific gravity of chlorine gas, the conclusion must be come to that this gas belongs to those kinds of vapours which only obey Mariott's law when it is at a temperature rather remote from that at which it is condensed to the fluid state. The specific gravity of chlorine at 20° C. is 2·4807; at 50° C., 2·4783; at 100°, 2·4685; at 150°, 2·4609; at 200°, 2·4502. According to experiments made by Stas, the specific gravity of chlorine, deduced from its atomic weight, is 2·45012. M. Ludwig has repeated experiments on this subject, and found the figures obtained and just quoted to be substantially correct.

On Allyl Alcohol.—M. B. Tollens writes to the editor as follows:—I find that allyl alcohol combines, although very slowly, with H_2, and no isopropyl alcohol is formed. When allyl alcohol is left for a considerable time in contact with a large excess of either sodium amalgam or zinc and dilute hydrochloric acid, some normal propyl alcohol is formed. When chlorine is made to act upon an aqueous solution of allyl alcohol, among other products I obtain a fluid boiling between 180° to 184°, and having its composition expressed by the formula $C_3H_6Cl_2O$; when this fluid is again treated with sodium amalgam, an alcohol is obtained. When this chloride, which happens to have the same composition as dichlorhydrin, is submitted to fractional distillation, I obtained one fluid which had its permanent boiling point at between 171° and 185° C.; the greater portion of the liquid distilled over at between 173° and 177°, a portion, however, also, at between 180° and 185° C.; the latter portion appears to contain the product derived from the action of chlorine upon allyl alcohol. Genuine dichlorhydrin boils at between 174° and 176° C.

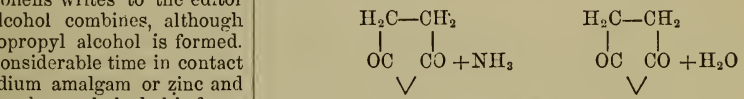
On the Products of the Destructive Distillation of Glycolic and Lactic Acids.—M. A. Krupsky records some experiments made by him on the products which glycollic acid yields when submitted to destructive distillation. 35 grms. of this acid were gradually heated, first to 120°, next to 160°, and at last to from 200° to 220° C., the retort being placed for several days in a metallic bath made of an alloy of 2 and 1-16th parts of lead and 3½ parts of tin, which alloy melts at 175° C. In the neck of the retort a solid substance sublimed, which could only be removed by breaking the neck of the same; on being removed, the substance was triturated in a mortar, first washed with alcohol, next with water. After repeated purifying, it was submitted to elementary analysis, and the result was—Carbon, 39·34; hydrogen, 6·69; the substance, therefore, is dioxymethylen. When lactic acid is exposed to a higher temperature, even below 200°, M. Krupsky found it to yield lactide; the most suitable temperature for the formation of this substance is between 210° to 215° C. Lactide is a solid, and exhibits beautifully rhombic crystals when its alcoholic solution is left to spontaneous evaporation. The author's advice to those who might desire to make this substance from lactic acid, is to take 100 grms. of the acid, to place it in a glass retort, heat first for eight or ten hours in a glycerine bath at from 100° to 110° C.; next the temperature is for thirty hours kept at from 135° to 140° C.; again the temperature is raised to 170°, and at last kept at from 210° to 215° C. for about forty hours; by this method, about 20 per cent of lactide is obtained from the quantity of lactic acid originally placed in the retort.

On the Melting Point and Relative Constitution of Succinimide.—M. Erlenmeyer observes, that when he made experiments on succinic acid and succinimide, the composition of which latter substance agreed entirely with the results obtained by Fehling, he was astonished to find that the melting of succinimide was not 210° C., as stated by some authors, but 125°. M. Teuchert having, in his essay on succinamic acid, repeated the statement about the melting point of succinimide at 210° C., M. Erlenmeyer has thought it his duty to review his work and repeat his former experiments, and, moreover, obtained from M. Fehling a quantity of pure succinimide; the melting point was again found to be 125° C. As to the constitution of this substance, I prefer to express it, says the author, by a formula written in the following manner:—



Succinimide.

Its origin from anhydrous succinic acid and ammonia is thus expressed:—



Neues Jahrbuch für Pharmacie redigirt, von Dr. Vorwerk, No. 3, 1869.

The present number of this periodical contains the following original papers:—

"*Soluble Saccharate of Oxide of Iron as Antidote against Arsenical Poisoning*," by Dr. H. Köhler. This is a paper containing the description of a series of experiments made upon living animals.—"*Characteristics of the Akazga Plant, and the Structure of its Wood, as compared with that of the Strichnos nux vomica*," Dr. R. Fraser. A botanical essay.

The remainder of the pages of this number of the periodical are filled with short abstracts taken from various periodicals published in England, France, and Germany; the greater portion interesting to our readers has been already published in these pages, we therefore confine our communication to the following:—

Analysis of Crude Cream of Tartar, Argol.—One gramme of this substance, taken from a thoroughly well mixed large average sample, previously powdered, is weighed into a tared porcelain crucible; the crucible and contents are heated to redness, and kept ignited until the contents are quietly in igneous fusion; let the weight of the residue found after cooling be called p. The crucible and contents are next boiled in distilled water, the fluid separated by decantation from the sediment is set aside, and the sediment washed until the wash-water no longer turns red litmus blue; the insoluble residue is dried at first on a water and next on a sand-bath. After its weight has been ascertained, it should be called r; $p - r$ is equal to the soluble portion of the ash which represents the carbonate of potassa. When the result of $p - r$, expressed in grammes, is multiplied by 271, the percentage of pure bitartrate of potassa is obtained contained in the sample of crude argol submitted to experiment; when the result of $p - r$ is multipled by 216, the percentage of crystallised tartaric acid is obtained.

Instability of the Solutions of Alkaloids.—A solution of 1 grm. of sulphate of quinine, 50 centigrms. of tartaric acid, and 20 grms. of water, was tested, after having been standing in a stoppered bottle for twenty months. It

contained 1·05 grms. of the saline constituents, instead of 1·40 grms., as when first prepared; it lost, therefore, 25 per cent. It appears, from communications received from various parties on this subject, that the same is observed to take place with most other alkaloids applied in pharmacy, and such solutions should not, therefore, be prepared for use in too large a quantity at the time.

Method of taking away the Bitter Taste of Epsom Salts.—When, in a solution of 30 grms. of this salt in 300 grms. of water, 10 grms. of roasted and ground coffee is boiled, and the fluid filtered, the bitter taste of the salt is entirely taken away, and the fluid pleasant to take.

Bulletin de l'Académie Imperiale des Sciences de St. Petersbourg, T. xiii., No. 4.

This paper does not contain any communications which are of any value for our purpose; most of the communications do not refer to exact sciences, and those which do, bear upon physiology, comparative anatomy, and crystallography.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 136, April 15, 1869.

The following are original papers :—

"*Velocity of the Psychical Functions of the Brain*," by Prof. F. C. Donders.

Adhesion of Hydrogen to Metals.—M. A. De la Rive.—The author, referring to a paper published by him in 1843, has now repeated some experiments, in order to prove that the pressure of air, by facilitating the adhesion of hydrogen to metals, may become an impediment to the continuation of some chemical reactions, which, on being first called into play, are not affected by this cause.

As regards the remaining papers in this periodical, as far as they belong to chemistry, we have already published their contents; the said papers not being original communications, but abstracts from works and periodicals published in various countries.

Zeitschrift für Chemie, von Beilstein and others.

The seventh number of this periodical for the present year contains the following original papers, some of which are very lengthy, and can, therefore, be only briefly noticed :—

Synthesis of Hydroparacoumaric Acid.—MM. Glaser and Buchanan.—They have essayed to substitute, for a hydrogen atom in the benzol nucleus of phenylpropionic acid, hydroxyl, in the radical C_6H_5 of the acid just alluded to; this they have done by first preparing the amido acid of the nitrophenyl-propionic acid, next converting that amido acid into the diazo combination, and, lastly, by decomposing that compound, by boiling it with water. They thus obtained paraoxyphenyl-propionic acid, which, on being tested, proved to be identical with hydroparacoumaric acid. In the course of their researches, the authors have met with a great many new compounds, among which the nitrophenyl-propionic acid—

$$C_6H_4 \begin{cases} NO_2 \\ C_3H_5O_2. \end{cases}$$

This is a solid substance, crystallises, exhibiting pale yellow crystals, difficultly soluble in cold, more readily in warm water, and very easily in alcohol and ether, and fuses at 153° C.; this acid forms readily soluble salts, which, however, crystallise difficultly. Hydrocabostyrol is also a solid substance; its formula is C_9H_9NO, fuses at 160° C., and can be distilled over at a higher temperature without decomposition. Amidophenyl propionic acid—

$$C_6H_4 \begin{cases} NH_2 \\ C_2H_5O_2. \end{cases}$$

Again a solid substance, crystallising, and then exhibiting beautifully quadrilateral prisms fusing at 131° C.; this substance forms, with acids, divers crystalline compounds. The other compounds we only briefly name, are the chloride of the diazophenyl-propionic acid, the oxyphenyl-propionic acid, and the parabromophenyl-propionic acid.

Action of Hydrobromic and Hydrochloric Acids upon Nitrobenzol.—H. Baumhauer.—Two and a half parts, by bulk, of a freshly-made aqueous solution of hydrobromic acid were mixed with one part, by bulk, of nitrobenzol, placed in a glass tube, and this, after having been sealed, was exposed to a temperature of from 185° to 190°. In this manner two substances were obtained—to wit, dibromaniline, which was in solution in the state of hydrobromate, and tribromaniline, which was left as an insoluble solid. When the experiment was repeated with hydrochloric acid, a crystalline substance was obtained, which the author has not further investigated.

Some of the Decompositions of Bromonitrous Acid.—M. L. de Koninck prepared this acid by means of saturating bromine cooled down to —10° with deutoxide of nitrogen; when an alcoholic solution of this compound is added to an alcoholic aniline solution, among other products, diazoamidobenzol is formed; when the aforesaid alcoholic solution was made to act upon nitrate of aniline, the author obtained a corresponding diazo compound. From this, and a series of similar experiments, the general result arrived at is that bromonitrous acid acts upon aniline as anhydrous nitric acid does upon that substance.

New Method of Preparing Cymol from Camphor, and on a Hydroxyl Derivate of Cymol.—Dr. R. Pott, while experimenting with camphor ($C_{10}H_{16}O$), tried to displace its oxygen by sulphur; and with that view he made sulphide of phosphorus, P_2S_5, act upon the substance; but, instead of succeeding with his intended substitution, he obtained cymol, since the sulphide of phosphorus acts by withdrawing water from the camphor, while, as by-product, a small quantity of a resin is formed at the same time. The best proportions for obtaining cymol by this method are five atoms of camphor to one atom of P_2S_5; the product obtained is purified by means of concentrated solution of caustic potassa and rectification over sodium. The hydroxyl derivative is obtained by fusing cymol with an excess of a mixture of potassa and sulphite of potassa, whereby a substance is formed, the formula of which, after having been properly purified previous to analysis, is $C_{10}H_{14}O$, a substance, therefore, to which the name thymol applies.

Hydroxyl Urea.—Drs. Dresler and Stein find that this substance originates when cyanate of hydroxylamine is formed from cyanate of potassa and a salt of hydroxylamine; the preparation of the hydroxyl urea, $N_2CH_4O_2$, is very complex, and, in consequence of the manifold operations required, too lengthy for description here. The resulting substance just alluded to is a solid, readily soluble in water, crystallises from alcoholic solutions in needle-shaped crystals, and fuses at between 128° and 130°C.; but if it be kept at this temperature for some time, it is decomposed, carbonate of ammonia is given off, and ordinary urea left. It is probable that the hydroxyl urea is, however, during this process of decomposition, first split up into cyanic acid and hydroxylamine. Solution of caustic potassa and strong nitric acid immediately decompose the hydroxyl urea. The author describes, also, a substance which he calls hydroxylbiuret, the formula of which is $N_3C_2H_5O_3$; it is a solid, soluble in water and alcohol, fusible at 134° C., but very readily decomposed, if kept, even for a few minutes, at this temperature.

Combination of Phosphoric Acid and Urea.—MM. Schmeltzer and Birnbaum have repeated some of Lehmann's experiments on this subject; they dissolved urea in a concentrated solution of ordinary phosphoric acid, and evaporated the fluid, without being warmed at all, over sulphuric acid in vacuo. In this manner a crystalline mass is obtained, which may be purified by re-crystallisation, after having been dissolved in distilled water and cautiously evaporated on a water-bath; the crystals thus formed belong to the rhombic

system, are readily soluble in water and alcohol, difficultly so in ether. The substance becomes decomposed when it is heated above 100°, giving off ammonia and carbonate of ammonia, and leaving metaphosphoric acid; the formula of this substance is CH_4N_2O,H_3PO_4. The authors state that other similar compounds have been obtained by them, and among these one containing 39 per cent P_2O_5, but this substance does not assume a crystalline shape.

Under the title of "Results of Researches made in the Chemical Laboratory of Professor Engelhardt, at St. Petersburgh," a paper follows, which is divided into three sections, each having a separate title:—1. "*Nitrotoluol and Amidotoluolsulpho Acids*," by M. Bek. 2. "*Isomeric Toluidine Sulpho Acids*," by J. Malyscheff. 3. "*Isomeric Naphthol and Benzoylnaphthol*," by Maikopar. However interesting these researches may be, the papers are too concisely written to admit of useful abstraction; and, from a foot-note placed at the end of these essays, we learn that researches on the same subjects have been made simultaneously elsewhere, and published, previous to the authors of the researches here referred to having had time to get their work printed and published in German.

The remaining few pages of this number of the periodical are filled with short paragraphs taken from the Chemical News, *Comptes Rendus*, and other periodicals, the subject matter of all of which has been noticed and published in our pages.

Les Mondes, Revue Hebdomadaire des Sciences, May 13, 1869.

We briefly notice, from the contents of this weekly paper, which are extremely varied, a proposal by M. Guignet—

To Preserve Butcher's Meat in Hot Weather, by placing it in large earthenware pans, putting clean heavy stones on it, and covering it with skim milk; the milk will become sour, of course, but may afterward serve as food for pigs, and the meat will be found to have kept its natural primitive freshness, even after eight or ten days.

Bronze.—It appears that at Berlin experiments have been made to determine under what circumstances the metallic alloy known as statuary bronze becomes most readily covered with what is technically called *antique patina*. As the result from a series of experiments, it appears that when genuine bronze is kept well cleansed, by washing the objects made of it with water, and next varnishing with oil, and rubbing the latter off with a piece of woollen stuff, and repeating this process once a month, it will produce the desired coating of patina very rapidly. Few of our readers acquainted with London are aware, perhaps, that the lamp-posts on London Bridge are, not as they seem, cast-iron, but genuine bronze, which of course, owing to the atmosphere it is exposed to, has become black.

Among the papers on geognosy, we meet with an interesting account of amber, too long for abstraction. This latter observation also applies to a paper of M. Dufour, on "*An improved Method of Examining the Flame of Burning Bodies and the Structure thereof.*"

The remainder of the papers relate to pure mathematics, and a long account of the meeting of the French Academy of Sciences.

Bulletin de la Société d'Encouragement, No. 195, March, 1869.

All the original papers of this number bear upon matters of engineering and mechanical science. The industrial notices contained in this publication, taken, as they are, chiefly from German papers, are rather antiquated; we only briefly notice—

Good Wholesome Bread.—Professor Stohmann advises to mix to $\frac{2}{3}$ parts of rye meal, $\frac{1}{4}$ part of bean or pea meal, and 2 per cent, by weight, of the mixture, of ordinary common salt. It appears that bread thus made is of excellent quality, taking its constituents into consideration, and easily digestible.

Copal Varnish, according to Professor Böttger's prescription, should be made by first dissolving one part, by weight, of camphor, in twelve parts of ether; when the camphor is dissolved, four parts of the best copal resin, previously reduced to an impalpable powder, are added to the ethereal camphor solution, placed in a well-stoppered bottle. As soon as the copal appears to be partly dissolved, and has become swollen, four parts of strong alcohol, or methylated spirits, and $\frac{1}{4}$ part of oil of turpentine is added, and, after shaking the mixture, and letting it stand for a few hours longer, a thoroughly good copal varnish is obtained.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 6, 1869.

At the meeting of the Society held on the 22nd of March, under the presidency of Professor A. W. Hofmann, the following papers were read:—

Peculiarly Modified Physical Structure of Banca Tin.—M. J. Fritsche states, that during the intense cold of the winter weather at St. Petersburg in the month of December, 1867, and the first three months of the following year, a large quantity of blocks of Banca tin, warehoused in that city, had been entirely changed in physical properties; the metal was swollen up, and the inside of the blocks, which had become simultaneously very brittle, so as to break very easily, had been entirely honeycombed. M. Fritsche instituted some experiments, by submitting tin of the same kind, not previously affected by the winter cold, to the action of an artificial freezing mixture made of solidified carbonic acid and anhydrous ether, without obtaining anything like the results produced by the long-continued intensely cold winter. No chemical change had been produced; as usual, this kind of tin was of great purity.

Some Derivatives of Naphthol and Naphthobioxyl.—MM. Darmstädter and Wichelhaus.—The authors say that they have met with considerable difficulty to obtain nitro-derivatives of naphthol by directly acting with nitric acid upon that substance; when, however, a solution of naphthol-sulphuric acid is placed in contact with nitric acid, a red colouration ensues, and a solid yellow-coloured substance is precipitated; this substance is the binitronaphthol, which crystallises from its solution in chloroform, and fuses at 138° C. Naphtho-bioxyl, obtained by fusing naphthalin-bisulphuric acid (naphthalin-bisulfosaure) with caustic potassa, is a solid substance which crystallises in colourless needle-shaped crystals, soluble in alcohol, ether, and chloroform, difficultly soluble in water; formula, $C_{10}H_6(OH)_2$.

Changes which Orthoformic Ether Undergoes.—M. H. Wichelhaus.—Orthoformic ether, $CH(OC_2H_5)_3$, when heated in sealed tubes with liquid ammonia, did not yield the product the author sought for; but, on repeating the experiment with aniline and the same ether, a solid substance was obtained, which, on being submitted to elementary analysis, yielded results leading to the formula $C_{12}H_{13}N_2$, thereby proving, in connection, also, with the chemical and physical properties of the substance, that it is identical with the body Dr. A. W. Hofmann obtained from chloroform and aniline.

"*Substances Isomeric with Hydrosulphocyanic Ether which agree with the Essential Oil of Mustard*," by Dr. A. W. Hofmann. This lengthy and very concisely written, and evidently condensed, paper, is too long for abstraction, with due justice to the merits of the researches described and to the eminent author.

The papers which follow, and the correspondence, have been noticed in our pages already.

Annales du Génie Civil, April, 1869.

As may be expected from the title, this periodical only occasionally contains papers, or communications, relating to chemistry. We notice in this number:—

Bachet's Process for the Manufacture of Caustic Soda.—When litharge, chloride of sodium, and water are mixed together, oxychloride of lead is formed, and soda set free, according to the following equation:—

$$4PbO+NaCl+HO=(PbCl+3PbO)+NaOHO.$$

The oxychloride of lead thus produced being treated with milk of lime, chloride of calcium is formed, and oxide of lead reproduced according to this equation:—

$$(PbCl+3PbO)+CaO=CaCl+4PbO.$$

The operation, therefore, consists in making oxide of lead act upon common salt, exhausting the soda thus formed by washing out with water and evaporating the alkaline fluid. The oxychloride of lead being insoluble, is placed in suitable apparatus, and mixed therein with lime-water, whereby the oxychloride is re-converted into protoxide of lead. The chloride of calcium obtained as by-product is, however, at present almost entirely valueless.

New Manure.—We learn from the same paper that a double salt of sulphate of ammonia and sulphate of manganese, found in the mother liquors remaining from the boracic acid manufacture at the *lagoni* of Tuscany, a salt hitherto useless, though containing from 7 to 8 per cent of ammonia, and about 10 per cent of protoxide of manganese, is now applied as manure, instead of crude sulphate of ammonia, and gives excellent results; as attested, also, by the well-known Prof. George Ville.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 17, 1869 (No. 20).

Omitting matters of purely mathematical, astronomical, and mechanical interest, we notice the following memoirs:—

Expansion, by Heat, of some Metallic and Non-Metallic Simple Bodies, and some Compounds of Hydrogen and Carbon.—M. Fizeau has experimented upon some forty substances, nearly one-half of which number has been for the first time submitted to a rigorously exact method of determining the co-efficient of expansion by heat between 10° and 80° C., and with masses varying from 2 to 16 m.m. The co-efficient of linear expansion of diamond is equal to 0·00000118; that of graphite, 0·00000786; that of pure cast platinum, 0·00000899; that of cast gold, 0·00001443; that of cast silver, 0·00001921; that of copper, native from Lake Superior, 0·00001169. These figures we quote only as instances of the amount of labour bestowed by the author on a subject requiring great nicety of manipulation.

On the Kaolin of La Lizolle and Echassieres, Departement of Allier, and Existence of Tin Ore at the same spot, which has been worked in remote Antiquity.—M. Daubrée.—Although this memoir is certainly of local interest only in its geological, mineralogical, and commercial bearing, it deserves to be noticed, on account of the fact that the working of these kaolin beds, situated almost in the very centre of France, have been, at a very remote period of antiquity, the scene of mining operations, executed with the view of obtaining tin ore, from which, moreover, metal has also been wrought there, as evidenced by vestiges of furnaces found in the neighbourhood.

Some Properties of Chlorosulphide of Phosphorus.—M. Chevrier.—Chlorosulphide of phosphorus, $PSCl_3$, is a colourless liquid, possessed of a rather irritating, but not at all disagreeable odour; boils at 124·5° C.; (when barom. 750 m.m.) at 20° C., its specific gravity is 1·636; its vapour is difficultly combustible, and forms, when mixed with oxygen, a slightly explosive mixture. This substance is not decomposed by a strong electric current, or a series of electric sparks. When the vapour of this substance is made to pass through a red-hot porcelain tube, filled with pieces of broken porcelain, the vapour is partly decomposed, sulphur is deposited, and a mixture of chlorosulphide and protochloride of phosphorus distils over. Water has the effect of slowly decomposing the chlorosulphide of phosphorus, thereby converting it into phosphoric, hydrochloric, and hydrosulphuric acids. This substance is also decomposed by chlorine; iodine and sulphur are readily soluble in this liquid, which is not acted upon by metals at the ordinary temperature of the air. Space forbids us here to enter into more particulars on the chlorosulphide of phosphorus, which has been exhaustively studied by the author.

"*Physical Constitution of the Sun; on the Results obtained by Spectrum Analysis, and by the Study of the Rotation of that Heavenly Body.*"—M. Faye, though an enthusiastic admirer of the results obtained by spectrum analysis, considers that the study of the mechanical effects of the rotation of the sun in producing certain phenomena on its surface, and in its photosphere, should not be neglected.—"*Influence of Temperature, as Affecting the Deviation of Gases from Obeying Mariotti's Law*," by M. Amazat. This is a condensed abstract from a larger paper, and too abstruse for further condensation.

Researches on the Phosphoric Acid present in that portion of Arable Soils which is Insoluble in Aqua Regia.—M. de Gasparin.—The labours of this gentleman reveal the fact, that even where there is the least appearance of the presence of phosphoric acid, it is met with in a quantity, which, if calculated for a surface of 1 hectare (2,471 acres), proves it to be relatively pretty abundant, though it be in a rather insoluble form. As instances, we take granitic sand from near Annonay (Ardèche), which in this way contains 0·62 per cent of its weight of this acid, amounting to 24,000 kilos. to the hectare. The siliceous diluvial sand of the borders of the Mediterranean contains 0·49 per cent, or nearly 20,000 kilos. to the hectare.

Solubility of Sulphur in the Coal-Tar Oils.—M. E. Pelouze.—Coal-tar oil, of 0·885 sp. gr., and distilling over at between 146° and 200° C., dissolves, at 15°, 2·3 grms. of sulphur; at 40°, 5·6 grms.; at 65°, 10·6 grms.; at 100°, 25·0 grms.; at 110°, 30·3 grms.; at 130°, 43·2 grms. As soon as the temperature decreases, the sulphur is precipitated in crystalline state, so that when the temperature was 130°, and the quantity of sulphur dissolved 43·2 grms., on cooling down to 15° only 2·3 grms. remain dissolved, and 40·9 grms. are precipitated. This property of the heavier coal-tar oils is made use of at the Paris gas-works to extract, from the materials which have been used in purifying gas according to Laming's process, the sulphur therein contained. The author of this paper reports very favourably on this plan, as greatly superior and less dangerous than the use of sulphide of carbon for that purpose.

This number also contains several papers relating to meteorology, and among these a very circumstantial account of the death, by lightning, of Captain Lacroix, of the Imperial Engineers, who was killed on the 7th of May last, while in his tent at the camp of Châlons-sur-Marne.

The American Journal of Science and Arts, March, 1869, No. 140.

This well-known and deservedly valued periodical contains, in its present number, the following original papers:—

"*Some Phenomena of Binocular Vision*," continued from a previous number, by Prof. Joseph Le Conte.

New Salt, containing Tin, Cæsium, and Chlorine.—S. P. Sharples.—This almost insoluble salt was accidentally discovered, and after having been purified, was found, on analysis, to consist, in 100 parts, of—chlorine, 35·84; tin, 19·49; cæsium, 44·67. The new salt will not serve for a quantitative separation of cæsium, as it is slightly soluble even in strong hydrochloric acid. Alcohol does not seem to have any influence upon the precipitation. If stannic chloride is added to a neutral solution containing CsCl, no precipitate is formed; but, upon adding to the solution about its own volume of strong hydrochloric acid, the salt is at once thrown down.

"*Atomic Volume of Liquids*," by Frank Wigglesworth Clarke. This extremely interesting and very concisely written paper is too lengthy for abstraction, an observation which equally applies to Dr. Wolcott Gibbs's paper "*On the Wave Length of the Spectral Lines of the Elements.*"

"*Condition of our Knowledge of the Processes in Luminous Flames*," by Eugène W. Hilgard.—This paper contains a review of what is at present precisely, and with absolute certainty, known on a subject which, as the author well remarks, has been too much taken for granted. His paper, full of quotations from the papers and published memoirs containing the results of experiments by himself and many other scientific men, is too abstruse for abstraction.

Notices of New Meteoric Irons in the United States.—Charles Upham Shepard.—Meteoric Iron from Auburn, Macon County, Alabama; specific gravity varied from 7·0 to 7·17, and gave 7·05 as the mean. The iron is free from chlorine, dissolves in hydrochloric acid without giving off sulphuretted hydrogen, and leaves behind a slight residue of thin, brilliant, blackish scales and needles. Its percentage composition, by analysing 2 grms. weight, was found to be:—Iron, 94·580; nickel, 3·015; phosphorus, 0·129; insoluble, 0·523; chromium, magnesium, calcium, silicon (?), and loss, 1·753; total, 100 000.—Meteoric Iron from South-Eastern Missouri. Specific gravity, 7·015—7·112; no chlorine. In 100 parts:—Iron, 92·096; nickel, 2·604; schreibersite, 5·000; chromium, cobalt, magnesium, and phosphorus, traces; a fine residue of $Fe_2O_3SiO_2$ and C. Neither copper nor tin was found.—Meteoric Iron from Losttown, Cherokee Co., Georgia. In 100 parts:—Iron, 95·759; nickel, 3 660; insoluble, 0·580; chromium, cobalt, tin (?), and magnesium, traces.

"*Nitrification*," by S. W. Johnson, is an essay on this subject, condensed from a lecture delivered before the National (American) Academy of Sciences.—"*Geological Notes on the Andes of Ecuador*," by James Horton.—"*Observations on Autumnal Foliage*," by Joseph Wharton, is a paper on chlorophyl and some observations and experiments made on this substance by the author, to which he has appended short abstracts containing the records of the results of the experiments on chlorophyl by Prof. Frémy and others; the author's experiments have more a physiologico-botanical, than a chemical bearing.

Modified Form of the Nitrate of Silver Test for Arsenic Acid.—Charles E Every.—The author has thoroughly studied and experimented upon this subject. It is known that arseniate of silver is slightly soluble in an aqueous solution of nitrate of ammonium, and readily soluble in both ammonia and dilute nitric acid; it is not easy to detect small quantities of arsenic by means of nitrate of silver, as usually employed, unless the test be applied with extreme care. The author found that the addition either of acetate of sodium, acetate of ammonium, or Rochelle salt, to a mixed solution of arsenic and nitric acids, is sufficient to ensure the immediate precipitation of arseniate of silver when ammonio-nitrate of silver is introduced. Instead of the acetates or tartrates, recently precipitated carbonate of silver may be employed to neutralise free nitric acid. When present in relatively large quantity, arsenic acid readily precipitates silver from a solution of nitrate of ammonium and ammonio-nitrate of silver, but the colour is uncertain.

Next follow:—"*Notices of Papers in Physiological Chemistry*," by Dr. George F. Baker; a long essay continued from a former number of this periodical. The scientific intelligence which concludes this number is partly abstracted from articles of journals and periodicals published in Europe, and is partly of local interest only.

NOTICES OF BOOKS.

A History of Chemical Theory from the Age of Lavoisier to the Present Time. By Ad. Wurtz, Membre de l'Institut (Académie des Sciences). Translated and Edited by Henry Watts, B.A., F.R.S. London: Macmillan and Co., 1869. Pp. 220, 8vo.

Our readers will recognise under the above title the "Discours préliminaire" which constitutes a kind of preface to M. Wurtz's "Dictionnaire de Chimie" now publishing in France. A work in the English language, and specially devoted to chemical history, appears so seldom in this country, that we purpose commenting upon it at somewhat greater length than the intrinsic merits of the book might appear to demand.

M. Wurtz's *history* commences with a brief introduction, which is followed by four chapters in which attention is directed to the respective doctrines of Lavoisier, Dalton and Gay-Lussac, Berzelius, and Laurent and Gerhardt. Another chapter is devoted to the discussion of existing theories; and this is followed by a few explanatory notes, to which the editor has judiciously added.

The opening sentences of the introduction are not likely to meet with very general acceptance among the chemists who are acquainted, even but a little, with the development of existing doctrines. That "chemistry is a French science," and that "it was founded by Lavoisier," are two propositions which reduce the whole subject, not only to a nationality, but to an individual, and neither of these propositions has any historical foundation whatever. We also feel bound to deny—in language no less decided than that of M. Wurtz, who affirms that, for ages preceding Lavoisier, chemistry "had been nothing but a collection of obscure and often fallacious receipts"—that Lavoisier's system was more scientific than that of Stahl, and that Lavoisier was "the creator of the true method in chemistry." Claims of this character invariably carry a doubtful appearance, and even a general reader would hesitate to admit them. It is surprising that M. Wurtz, in his zealous and just endeavour to honour the memory of a truly great man, should estimate the labours and ideas of the ancients at so paltry a value; for, considering how little real novelty can be attributed with certainty to the French chemist, and how much he derived from his immediate and remote predecessors, Lavoisier himself is the only loser by the comparison. It must not be forgotten, however, that we are dealing with a traditional method. No sooner had Lavoisier formed in his own mind a clear conception of the plan he was about to pursue, and collected a few able associates around the regal standard, than he boldly named his system "French Chemistry." There was much art in that designation. In the first place he made interest with the vanity of his nation; in the second, he ignored antiquity; and, lastly, he thereby ensured the perpetuation of his personal fame. This title, however,—the sagacity of which we cannot but admire,—was accompanied by a great deal of practical arrogance. Chemistry in France, instead of following its own natural development, was dispensed by a despot and his courtiers. In Germany the schools were insulted by the information that Stahl, their common and respected master, was destitute of common sense, and his theory of phlogiston a delusion; so that we cannot much wonder at the slowness with which the new system crossed the Rhine. In England it soon found powerful (and, perhaps, too partial) advocates, though even some of these were offended at Lavoisier's dictatorial manner and disingenuousness.

It has always been admitted, and we think with much correctness, that Lavoisier's achievements are all connected very intimately with the study of oxygen. No one could have better pointed out the logical value of his deductions, or the admirable sequence of his reasoning, than M. Wurtz has done in this volume. But we owe the discovery of oxygen to Priestley and Scheele; that it constitutes a part of the air, and is the one important agent both in combustion and calcination, were facts known to Hooke [whose name is omitted from this chapter]. The increase in weight of metals when calcined had been acknowledged, we need hardly say, long before Lavoisier. Cavendish and Watt were the first to ascertain the composition of water. Black established the doctrine of latent heat (which is left unnoticed

here). These are the essential, indeed the only, bases of Lavoisier's system. What, then, becomes of the statement that "chemistry is a French science?" Surely Davy was well warranted in saying "his discoveries were few, but he reasoned with extraordinary correctness upon the labours of others." Lavoisier's merit rests in the circumstance that he combined the scattered links which we have mentioned into a firm and single chain; not in the deceptive supposition that he inaugurated a new era. As an innovator he failed entirely. Few conceptions could be more gross or retrograde than that of oxygen as the acidifying principle, or (as he at one time conjectured) than that of nitrogen as the alkalizing principle. It is clear, in fact, that the general acceptance of Lavoisier's system by his contemporaries depended on the very circumstance that it was, in its separate details, essentially old and not new.

We must not omit to notice the stress that many writers have laid upon the quantitative character of Lavoisier's experiments, involving, as it is commonly believed, the first introduction of the balance into chemistry. This fallacy is very well exposed by Mr. Watts, who, in a note at the end of the volume, gives a detailed account of Black's famous research on the nature of mild and caustic alkalies. Professor Wurtz, who is silent on this point, certainly mentions the memorable analyses of Wenzel, and the philosophic intention with which they were undertaken; but why the German chemist should be said to have "toiled in the dark" (*travaillait obscurément*) does not altogether appear, unless we are to allow that the brilliant Frenchman involved his contemporary in a total eclipse. Strictly speaking, the idea of weight does not possess so great a value as is commonly assigned to it, and a science of chemistry might very well exist without that idea as a factor. The broader and necessary conception of *number* was, in reality, and in this respect, what Lavoisier so eminently aided in announcing. That the notion of the indestructibility of matter even presented itself to his mind as a clear inference is very improbable, or, at least, an open question.

The study of the functions of oxygen had naturally led Lavoisier back to dualism; that is to say, he had re-established, but on a wider experimental basis, the fundamental conception which we owe to the iatro-chemists. Thoroughly conscious of the true value of language, he added to the maxims of Condillac the practical efforts of Morveau. Morveau was induced to abandon the phlogistic doctrine; a committee was appointed with Lavoisier at its head, and a nomenclature soon appeared from which the name of phlogiston was absent, and which embodied the spirit of the rising school. That nomenclature was undoubtedly a great success in its time, and its establishment was justified on principles to which few will deny either wisdom or foresight.

The idea of number soon assumed a very important phase in connection with chemistry. The law of multiple proportions, first observed by Higgins, and re-discovered by Dalton fifteen years subsequently, received, at the hands of the latter philosopher, an interpretation in accordance with the ancient notion of atoms. Higgins represented these atoms as held together by mutual forces symbolised by lines. Dalton employed in his lectures a wooden sphere with radiating spokes. The modern notion of atomicity (if any clear notion really exists on such a subject) has, therefore, a somewhat remoter parentage than is commonly assigned to it. The announcement and gradual acceptance of the atomic theory mark especially an influx of materialism which has already reached its highest point, and is now commencing to recede from the steady shore of philosophic thought. M. Wurtz speaks strongly in praise of Dalton, whose name, he says, "is one of the greatest in chemistry," and points out, also, in this chapter the well-known relation between Gay-Lussac's great discovery and that of his English contemporary. The parts taken respectively by Avogadro and Berthollet on the latter question are also very clearly and excellently stated, but, perhaps, a little too briefly.

Berzelius adopted the atomic theory, but did not contribute to it any modification of serious importance. His quantitative work, though, doubtless, suggested by that theory, is, in its results, quite independent of any theory. Like Lavoisier's, his system was essentially dualistic, but his dualism was in many points different from, and superior to, that of his French predecessor, and had the advantage of reposing on a purer dynamics. The "binary theory," as it has been termed, was hardly ripe for discussion when a warm controversy took place between Berzelius and the French school led by Dumas. But we must refer the reader to M. Wurtz's book for a detailed and lively account of the campaign. The disorder, confusion, and misapprehension of the real question at issue have certainly not been surpassed in scientific history. Berzelius originated our present symbolic system, and the nomenclature which he had introduced, revived as it has been by Williamson, is gaining favour in this country.

The next chapter is devoted to an account of the doctrines of Laurent and Gerhardt. How far these great men, whose names will be for ever united in one dualistic formula, ever really adopted the atomic theory, is somewhat difficult to ascertain, and was, perhaps, unknown to themselves. That they protested against any representation of atomic arrangement is certain; but they adopted atomic language on many occasions. The doctrine of types and the numerical criteria of formulæ largely occupied their attention, but the idea of Gerhardt's "series" was borrowed from Avogadro.

M. Wurtz's final chapter is devoted to a lengthy discussion of the theories which prevail at the present day; their immediate origin and interdependence are pointed out with great clearness and force. It is stated, and with much truth, that these theories are essentially atomic; and the author, who has himself largely contributed to their success, of course heartily supports them. We do not propose to criticise them in this place, for such a procedure would hardly fall within the province of a contemporary reviewer, but content ourselves with warning students to suspend their judgment upon any corpuscular doctrine until they are really able to decide upon it for themselves. The influences of atomicism are so subtle that, if once committed to their acceptance, it is almost impossible for any mind to effect an escape.

We cannot, in conclusion, refrain from expressing our thanks to M. Wurtz for an account of chemical history in which, though some serious errors occur, there is so much to gratify and attract. The style is so lively and energetic, the argument so deductive, and the meaning so unmistakable, that we cannot help feeling how great a contribution has been made towards satisfying a real want of our time; and we commend the work to our readers with all the more confidence, because the editing and translation have been so judiciously executed. The notes which Mr. Watts has added are, moreover, evidences of the importance which he is well known to attach to an impartial statement of facts, and will serve to remedy some of the faults we have alluded to. Chemical literature in England owes a fresh debt to Mr. Watts, and we sincerely hope that his edition of M. Wurtz's *discours préliminaire* will aid in reviving a taste for a neglected but most important branch of literature.

A Course of Six Lectures on the Chemical Changes of Carbon. By William Odling, M.B., F.R.S., Fullerian Professor of Chemistry, Royal Institution. Delivered before a Juvenile Auditory at the Royal Institution of Great Britain during the Christmas Holidays of 1868-69. London: Longmans, Green, and Co.

Few men who have ever devoted themselves to chemistry, forget their first attendance at a chemical lecture. The lecturer may not be profoundly learned, or even a brilliant manipulator—he may use hard words, and omit to explain them; he may totally fail in some experiments, and only

partially succeed in others—it matters not; to an intelligent and imaginative boy there is a magical charm about the new world thus opened to his mind which time can never efface.

But replace the school-room by the theatre of the Royal Institution, the amateur or itinerant lecturer by Faraday, the imperfect apparatus by all the appliances which refined science can suggest; can we then wonder if the impressions so formed exercise a lasting and glorious influence over the mind of the youthful spectator?

Only those who have seen the rapt and delighted gaze of the juvenile audiences, as they followed, with intelligent appreciation, each experiment and explanation of Faraday, can fully appreciate the enormous amount of good which must arise from these lectures.

The worthy successor of Faraday, in his Chair at the Royal Institution, has so far followed in the footsteps of his predecessor, that he has continued to give lectures to the young, and with eminently successful results.

The present series of lectures on the chemical changes of carbon will be found to contain all that can be said upon the subject capable of being comprehended by a juvenile auditory; and being printed as they were taken down *verbatim* by the reporter of the Chemical News, they possess all the vivacity, as well as originality and clearness of style, which distinguish the eminent chemist by whom they were delivered.

A remarkable feature in these lectures is the fact that every term made use of is defined as it occurs, and the oral definition is supplemented by a clear and decisive experimental illustration.

It must not be forgotten that *Carbon*, in some respects, stands alone among the elements. Its compounds are more numerous than those of any other element, and their history by the older chemists was considered to constitute a distinct branch of the science, and called "Organic Chemistry." In the present day, the results of research have been to break down the barriers which were supposed to exist between organic and inorganic chemistry; and it has been found that a vast number of bodies, at one time supposed to be producible only by the agency of animal or vegetable life, can now be formed by the chemist from absolutely inorganic matter. The result of these discoveries has been that the phrase "Organic Chemistry" is, by the more advanced chemists, abandoned for the more accurate term, "Chemistry of the Compounds of Carbon."

While reminding our youthful readers that the chemistry of carbon includes the chemical history of all animal and vegetable substances, we cannot, we think, offer them better advice than to commence that grand study by a careful perusal of Dr. Odling's Lectures "On the Chemical Changes of Carbon."

Chemical Labels, according to the latest System of Nomenclature. London: H. K. Lewis. Price 1s.

A series of Chemical Labels, with Symbols, arranged according to the New Notation. Leeds: Harvey, Reynolds, and Co. Price 6d.

Complete Series of Photographic Labels, including Solids and Solutions, with Duplicates and Blank Labels. Leeds: Harvey, Reynolds, and Co. Price 6d.

Mawson and Swan's Book of Chemical Labels. Revised Edition. Newcastle-on-Tyne: Mawson and Swan. Price 1s.

Few things are more necessary for a chemist's laboratory than good, boldly printed labels, and, for the student of the present day, it is almost essential to use those in which the old and new formulæ are given.

The first of these series has been very carefully compiled by Mr. Henry Matthews and Mr. C. W. Quin, whose names alone are sufficient to guarantee an expenditure of time and thought in their arrangement, which cannot fail, in a great measure, to meet the requirements of the analytical chemist. The compilers have, we think, been judicious in selecting labels for those tests and reagents only which are in constant use.

Messrs. Harvey and Reynolds's series are arranged according to the new notation, and only the new formula is given; the type is clear and distinct, and the book is well worth the moderate sum charged for it.

Photographers will do well to avail themselves of the useful and complete set of labels for photographic chemicals, which appears to contain all the solids and solutions in present use. We would, however, suggest that, in a new edition, the word *poison* should be annexed to such substances as cyanide of potassium, &c.; for, although it is not customary for wholesale houses to take this precaution, it is highly necessary for it to be observed, where poisons are in constant use; and especially for cyanide, which is used in solution for fixing positives, by young amateurs and others, who are not always the most careful with poisons.

We are glad to find that the revised edition of Mawson and Swan's labels is free from the many imperfections of the first. The labels are alphabetically arranged, with the inner margins perforated. The names and formulæ accord with the latest editions of "Fownes," "Roscoe," and "Fresenius," while, in most instances, the old names and formulæ are given in italics. The term *acid* is restricted to hydrogen salts, and the specific gravities of the strong and dilute acids as well as the proportions of acid to water are given. Labels intended for solutions of salts bear the word "solution," and the various states of tests and reagents are appended, thus obviating the practice of using the same label for a salt, whether it contains water of crystallisation, or is in a state of fusion, or in solution. We can certainly say of this edition what we could not conscientiously say of the first, that it has been compiled with an amount of care and attention which could only be bestowed by a chemist well versed in both the old and new systems of nomenclature and notation, and fully maintains the high character the publishers have attained as manufacturers of chemical apparatus and pure chemicals.

CORRESPONDENCE.

Equivalence and Quantivalence.

To the Editor of the Chemical News.

Sir,—As an admirer of the logical and very appropriate moderation evinced by the President in the discussion at the last meeting of the Chemical Society, I would moot that Mr. Ward's attack is not altogether in good taste; his long letter of nearly three columns is a reiteration of the "Hofmann" text without a single emendation or improvement. He may write grandiloquently of the all-important and momentous law of quantivalence; but Chemistry is making progress, and since the work of Hofmann newer and profounder treatises have appeared with admissions that may well justify the humble and cautious attitude referred to.

It is not true that the doctrine of equivalents only leads to the question *How much?* for it equally embraces the *How many?* Nor is it at all denied the full benefit of volumetric guidance, with all other physical and chemical aid.

What more does the momentous law of quantivalence provide? Mr. Ward says that N is trivalent. Mr. Equivalent says that in relation to H it is trivalent or triatomic; but is it so essentially or *per se?* Mr. Ward says not! Is the trivalent or "equiquantic" nitrous acid the most definite or stable of its oxy-combinations? Mr. Ward says not! Is this momentous law in any way the expression of chemical force or "chemism?" Mr. Ward says not!

Is S''O'' equiquantic? Because, as that is the weakest of its principal forms of combination, peradventure quantivalence may be a law of weakness.—I am, &c.,

Chemicus.

On a Remarkable Passage in Priestley's "Letters to Canton."

To the Editor of the Chemical News.

Sir,—Being engaged in arranging the Canton Papers, which belong to the Royal Society, I have come to a letter of Dr. Priestley, addressed to his friend Mr. Canton, and dated "Leeds, 12th November, 1767." After describing some experiments on the melting of brass and steel wires by the electric shock, he concludes his letter in these terms:—

"You will think I talk strangely, but I own that these experiments, together with that of the insulated hot glass mentioned p. 716 of my book, and others too long to recite here, make me inclined to think there is no electric fluid at all, and that electrification is only some new modification of the matter of which any body consisted before that operation."

It is remarkable that Priestley here anticipates the theory which is now generally adopted by electricians. I cannot find, however, that he assumed it permanently, or decisively; on the contrary, he strongly inclined to Franklin's hypothesis of the positive and negative state of all electrified bodies. With a view to ascertain his opinion, I have examined the five editions of his "History of Electricity," and also his "Familiar Introduction to the Study of Electricity." He considers Franklin's theory to be "the most probable of any that have been hitherto proposed to the world" (Hist. of Electricity, part 3, § 2). After a full discussion, he speaks of it in the following terms:—

"Dr. Franklin, the author of this excellent theory of positive and negative electricity, with a truly philosophical greatness of mind to which few persons have ever attained, always mentions it with the utmost diffidence. 'Every appearance,' says he, 'which I have yet seen, in which glass and electricity are concerned, are, I think, explained with ease by this hypothesis. Yet, perhaps, it may not be a true one, and I shall be obliged to him who affords me a better.'"

At the time when Priestley and his friends were employed upon these researches, the celebrated Father Boscovich had attained to the summit of his fame. In the year 1760 he was elected a Fellow of the Royal Society, having visited London and enjoyed the intercourse of some of the most eminent philosophers of this country.* His theory of the constitution of matter, according to which it consists of centres of attraction and repulsion, had become generally known. Both Priestley and his friend and neighbour, Michell, had been interested in it.† We may infer that, in proportion as Priestley regarded with approbation "this sublime theory of the constitution of matter," he must have been inclined to regard electrical phenomena in the same light, which he has clearly propounded in the above-quoted passage.—I am, &c.,

James Yates.

Lauderdale House, Highgate, N.,
May 8th, 1869.

Alkali Works.

To the Editor of the Chemical News.

Sir.—I beg leave to ask the opinion of your readers to the following questions.

(1.) Should not alkali works, when they are enrolled under an act of parliament, be exempt from proceedings at law, unless the prosecution is conducted by, and is the result of infringement detected by, the Government Inspector appointed for that purpose?

As a great many cases have, within the last year or two, been brought before the county courts by farmers, and, as the verdict, in the majority of them, has been against the manufacturers, notwithstanding that the Alkali Inspector has appeared as a witness on the opposite side to the farmers, and testified to the complete state of condensation at the time, the following other question suggests itself.

(2.) Should not a special scientific legal court be formed for the trial of these cases?

The legal gentlemen connected with county court business laughingly admit their ignorance of chemistry, and at least one judge is exultingly spoken of by farmers as being "dead against chemical manufacturers;" and my impression is that there should be a proper tribunal, and the Inspector, and he only, should be the prosecutor. In Mr. Stephenson, M.P., South Shields (a large manufacturer of chemicals), and Dr. Lyon Playfair, we have good representatives, and I trust they will keep a vigilant lookout.—I am, &c.,

"An Interested Person."

May, 1869.

Equivalence and Quantivalence.

To the Editor of the Chemical News.

Sir,—Mr. Ward, in a communication to the Chemical News of April 30th (*Am. Repr., June*, 1869, *page* 331), appears to misunderstand the point referred to by Dr. Williamson, since he evidently confounds the terms *equivalent* and *atomic weight*. Your readers will, doubtless, admit the justice of Dr. Williamson's remarks, when they see clearly put before them the theory of equivalence and that of atomicity, or, as Mr. Ward well calls it, of quantivalence.

Let us take the two chlorides of phosphorus, PCl_3 and PCl_5. The theory of equivalence asserts that, in the former, the equivalent weight of phosphorus is $\frac{31}{3}$, that of chlorine being 35·5; while that, in the latter, the equivalent weight of phosphorus is $\frac{31}{5}$; in a word, that the quantivalence of phosphorus is variable. Those who uphold the theory of quantivalence, assert that phosphorus is, under all conditions, trivalent. They maintain that, in compounds resembling phosphoric chloride, the two extra monad atoms (or what is equivalent to them) are combined with the phosphorous compound, in much the same way as that in which one salt combines with another salt to form a double salt. The quantivalence of phosphorus, according to this theory, is invariable.

It would be difficult to find two theories more antagonistic than these. It was, therefore, with great justice that Dr. Williamson complained that many chemists employ the terms equivalent and atomicity indiscriminately; seeing that the former implies a variable, the latter an invariable, quantity.

It is necessary to draw attention to the abuse of the word "fact" in Mr. Ward's letter. He does not distinguish clearly between a *fact*, and a *theory* founded upon facts. The equivalent weight of an element in any particular compound is a fact; its atomic weight and its quantivalence are theories founded upon facts. All chemists agree that, in marsh gas, the equivalent weight of carbon is 3, that of hydrogen being 1; but some ascribe to carbon the atomic weight 6, others 12; and hence we have the different molecular formulæ—

$$C_2H_4 \text{ and } C\,H_4,$$
$$(6) \qquad (12)$$

both representing marsh gas. In the same way, some assert that carbon is divalent; others that it is tetravalent. If the atomic weight and the quantivalence of carbon were facts, what ground would there be for any dispute?—I am, &c.,

Temple A. Orme.

University College School, London,
May 8th, 1869.

A Plea for the Word Quantivalence.

To the Editor of the Chemical News.

Sir,—Most chemists seem disposed to accept the notion of atomicity, but apparently object to the word itself. The ideas conveyed by the terms monatomic (H′. &c.), diatomic (O″, &c.), triatomic (N‴, &c.), tetratomic (C⁗, &c.), more or less

* Fabroni, "Elogi," Tomo ii., p. 41; Rees's "Cyclop.," vol. v., article Boscovich.

† Priestley, "History of Discoveries relating to Vision." "Inquisitions relating to Matter and Spirit," vol. i., pp. 24-42.

modified, are generally agreed to, the names themselves rejected. The cause of this rejection is found, doubtless, in the fact that, instead of conveying to the mind the intended impression of the single, double, triple, and quadruple *value* of atoms in forming molecules, the words monatomic, diatomic, triatomic, and tetratomic give the erroneous impression of *number;* a diatomic body, for instance, is liable to be regarded as containing two atoms, whereas double value alone is intended. In place of these names those of univalent, bivalent, trivalent, quadrivalent, about which there can be no ambiguity, are being adopted by leading chemical authors; but as to which of the words *equivalence* and *quantivalence* shall displace *atomicity* there is difference of opinion. The appellations "equivalence" and "equivalent" are claimed as well known and as covering all the ground commanded by "quantivalence." This they do, undoubtedly, but the objection to them is that they do much more and, from their relative nature, possess any meaning required by the context. The word *equivalent* (with which *equivalence* is indissolubly connected) is not only frequently required and used, and rightly so, by chemical and other authors in several different general senses, but, employed in reference to a chemical atom, it may properly be intended to have distinct meanings. Thus, in regard to the exchangeable values of atoms of chlorine, oxygen, nitrogen and carbon, their respective equivalents are commonly 1, 2, 3, 4, while in displacing 1 part by weight of hydrogen their equivalents will be $35\frac{1}{2}$, 8, $4\frac{2}{3}$, 3, and in forming molecules, $35\frac{1}{2}$, 8, 14, 6, according to old notions, and $35\frac{1}{2}$, 16, 14, 12, according to new ideas. To speak of atomicity (or the subjects of univalence, bivalence, trivalence, and quadrivalence), under the general term *equivalence* is to place unnatural restrictions on the latter word, and divorce the term *equivalent* from proper associations. On the other hand, *quantivalence* is open to none of these objections, and fully satisfies all requirements.

The philology of the matter is indisputable. Let us have either monatomic, diatomic, triatomic, and tetratomic, or univalent, bivalent, trivalent, and quadrivalent; not such hybrids as biatomic or divalent. Pupils of indifferent education also need sometimes to be reminded that the correct pronunciation of the quan-tiv'-a-lence terms is u-niv'-a-lent, biv'-a-lent, triv'-a-lent, quad-riv'-a-lent.—I am, &c.,

John Attfield.

17, Bloomsbury Square.

Equivalence and Quantivalence.

To the Editor of the Chemical News.

Sir,—I would suggest that the quantivalent discussion has not made good progress.

Mr. Orme unfairly insists that equivalent notions involve an "equivalent weight" of nitrogen in ammonia to be $\frac{1}{3}^{4}$, &c., &c.

Between the modern views of "atomicity," as cautiously put forth by Wurtz and other leading chemists, and the older views of "equivalents" there is, I moot, *no essential difference.* To both the N of ammonia is equally triatomic or trivalent.

But Mr. Attfield takes up an entirely new position, viz.—that quantivalence is an essential quality *per se.* If it could be shown that N is equally trivalent in nitrous oxide, nitric oxide, nitric acid, the peroxide, and also in nitric acid, and similarly for other multiple combinations, then the matter would be settled.

It is true that ammonia is a leading and characteristic type of combination between N and H, but it is not exclusively such.

The ratio is—

1 to 2 in amidogen.
1 to 3 in ammonia.
1 to $3\frac{1}{2}$ (2 to 7) in atmonium?
1 to 4 in ammonium.

The atmonia ? type is not well recognised, but it is becoming very prolific in the innumerable amides, ureas, urcides, &c., &c.—I am, &c.,

Chemicus.

Alkali Works.

To the Editor of the Chemical News.

Sir,—In my letter on "Alkali Works," which you kindly published on the 14th inst. (*Am. Repr., July,* 1869, *page* 44), I did not explain my ideas very fully for fear of intruding too far upon your valuable space, but after your remarks in last week's Chemical News (and for which I heartily thank you), I request your indulgence while I make a few supplementary notes.

Alkali Works are now generally conducted by men with considerable scientific and practical knowledge, and much care and attention is applied in order to obtain in all cases the full produce, *i.e.*, as near the theoretical as possible, from all materials, whether solids or gases, and as this can be and is accomplished without any appreciable loss, I assumed and worked upon this assumption when I made my remarks, that no gas did or was liable to escape, except muriatic acid, and as this was under the supervision of an inspector appointed for the purpose, I considered that he was the one to prosecute if such was necessary.

To expect no odour whatever from a chemical works is too much, as it is, for instance, impossible to run still liquor off without a slight smell; but any constant escape of sulphuric or nitrous gas is quite unnecessary, and in such cases by all means let farmers and others have some means of getting redress for damage done. But, again, care must be taken that a system of *persecution* is not resorted to; and without a Court is formed for the trial of these cases, which can sift and understand the *scientific defence* of the defendants, such a state of things will result, as, for instance, I see before me a chemical works surrounded by a few other works, not alkali, but for all that emitting acid gases (glass, and other works). These are situated in an agricultural district, and consequently, the people about there are more sensitive at their nasal members. The alkali works may have got an hereditary bad name, but no gas is allowed to escape now, yet the representatives of agriculture in that neighbourhood would, in case they saw their crops injured by gases, at once complain of the alkali works and never suspect the glass works. The reason of this is, that the uninitiated, in passing the former works, no doubt will smell an odour, while, in passing the latter, they will not smell any, and they at once, in their ignorance, put down as a fact, that the alkali is the guilty work. They do not know that, if an alkali work is properly conducted, no gas, in such a quantity as to do harm to agriculture, is allowed to escape, and that the mere puff or smell they experience in passing is quite unavoidable (as coming off, say, still liquor when being run off), but, at the same time, quite harmless, although it does go direct and affect their smelling power. Again, in their ignorance, they are not aware that other works, such as glass, are allowed to evolve *streams* of gas from their chimneys, which, instead of making itself known to every passer-by, goes, or rather is blown quietly, but in an unremitting stream, on to the adjoining fields. If a case of this sort was brought before a county court, as at present constituted, the verdict would go against the alkali manufacturer, because the judge, not understanding the chemical defence, would take the same view of the case as the farmer. I beg to ask if this state of things is fair?

For my part, I do not by any means wish to deprive farmers and others from complaining, but, knowing as I do the care that is taken by some people to prevent, and how unnecessary it is to allow gases to escape, I only wish that justice may be done to those who, perfectly innocent, may yet be so unfortunate as to be blamed for gases allowed to escape from contiguous works, unsuspected, perhaps, simply because they are *not* alkali works.—I am, &c.,

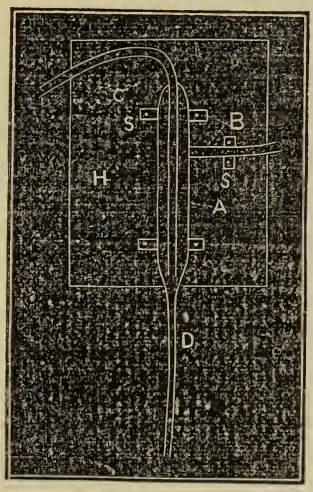
An Interested Person.

Laboratory Pump.

To the Editor of the Chemical News.

Sir,—As you published some weeks ago an account of Professor Bunsen's valuable filter pump, I may take the opportunity of describing a simple form of this pump which has been fitted up in my laboratory by Mr. Stephen Yeates, of Dublin.

The accompanying diagram shows the essential parts of the pump. A is a tube of tin, about eight inches long, and of nearly one inch internal diameter; within three inches of one end the tube B is soldered. The diameter of this tube should be about $\frac{3}{8}$ of an inch. The end of the wide tube most distant from B is now contracted so as to form a portion of a cone, and D then soldered in. A small tube, C, is now selected, one extremity of which enters, but must not at all close, the cone formed by the junction of A and D; and at this point its orifice is contracted, so as not to exceed $\frac{1}{8}$ of a inch in diameter. It is then soldered, as shown, into the upper end of A. The whole arrangement is fitted to a board by the straps, s, s.



The tube, C, is connected with the vessel to be exhausted of air. B is the delivery pipe for water, obtained from a cistern or from the street main; the supply should admit of regulation by means of a stop-cock placed in the course of B. In order to obtain the maximum exhaustion with the pump, the length of D should be about thirty-three feet, but a fall of twenty feet I find to be more than sufficient for ordinary water. As this form of Bunsen's pump can be constructed by any intelligent plumber for a few shillings, no chemist need be deterred, either on account of expense or trouble, from fitting his laboratory with the new apparatus.

I have had the pump in operation in my laboratory for about two months, and gladly bear testimony to the great practical value of Professer Bunsen's admirable arrangement. —I am, &c.,

J. Emerson Reynolds.

Laboratory, Royal Dublin Society,
Kildare Street, Dublin,
April 26th, 1869.

NOTES ON LECTURE EXPERIMENTS.

Colouring Carbonic Acid.—Carbonic acid may be coloured brown by nitrogen peroxide. This gas is easily obtained by heating lead nitrate in a test-tube, and by means of a bent tube, conducting the brown fumes into the vessel containing the carbonic acid. Bromine vapour may be used, but the smell is very disagreeable. A simple method of rendering carbonic acid visible is that described by Priestley—"Experiments and Observations on Different Kinds of Air," 3rd edition, 1781, pp. 25-6—viz., by extinguishing lighted candles, paper, &c., in the gas, when the smoke clings to it, rendering it visible. If gunpowder be fired in a large vessel filled with carbonic acid, the smoke, as stated by Priestley, scarcely escapes from the vessel; and, on tilting the vessel thus charged with carbonic acid and smoke, the pouring out of the gas is rendered distinctly visible even from long distances, forming, as a friend of mine used to say, a "*gascade.*"—C. J. Woodward, Midland Institute, May 3rd, 1869.

Hydrogen Bottle.—Thin sheet-lead is worked into the shape of a round bottle, with a wide neck to hold a cork; a gas-cock in the dome or neck of the bottle. Before joining the bottom, a perforated tray of lead is inserted, about 2 inches up into the bottle. A short bit of lead pipe ($\frac{1}{2}$ inch) opens into the bottle below. The first idea proposed a cylindrical chamber, fastened to the bottle towards the top, and communicating, by pipe, with the opening below. Into this chamber the liquid is forced by the gas. The suggestion of this year is simple—To put the bottle into any vessel with acid solution. A large quantity of granulated zinc may be put on the tray. This, and the bottle being of lead, galvanic action promotes the evolution of gas, which forces out the liquid, &c, as in the hydrogen lamp. I used the bottle in the simple form this year, and found it all that could be desired. Even the cleaning is easily done. The oxide and sulphate fall through the tray to the bottom and wash out.—Richard McNevin; Edward Cannon (1862). Christopher Dunn (1869), Clongowes.

MISCELLANEOUS.

The Royal Society.—The following is the list of the gentlemen who have been selected by the Council for election into the Royal Society this year: Sir Samuel White Baker, M.A., eminently distinguished as a geographer and explorer of distant lands; John J. Bigsby, M.D., distinguished as a geologist and palæontologist; M. Charles Chambers, director of the Colaba Observatory, Bombay; Mr. William Esson, M.A., of Merton College, Oxford; Mr. George Carey Foster, B.A., Professor of Physics in, and Fellow of, University College, London; William W. Gull, M.D., London, distinguished as physician and as a teacher of the medical sciences; Mr. J. Norman Lockyer, distinguished as an astronomer; Mr. John Robinson M'Clean, C.E., late President of the Institution of Civil Engineers; Mr. St. George Mivart, Lecturer on Comparative Anatomy at St. Mary's Hospital; John Russell Reynolds, M.D., Professor of Clinical Medicine in University College, London; Vice-Admiral Sir Robert S. Robinson, K. C.B., Controller of the Navy; Major James F. Tennant, R.E., late Astronomer at Madras; Wyville Thomson, LL.D., Professor of Zoology, Botany, and Geology in Queen's College, Belfast; Colonel H. E. Landor Thuillier, R.A., eminent as an Indian geographer; and Mr. Edward Walker, M.A., distinguished for his mathematical and literary attainments.

"Previous Sewage Contamination."—A discussion is going on at the meetings of the Metropolitan Association of Medical Officers of Health on the subject of "Contamination of Potable Water by Sewage," and the following are questions having especial reference to *rivers*, on which information is desired:—

Supposing town sewage, discharge of water-closets, &c., to be poured into a running stream, does it undergo oxidation, so that its noxious qualities are lost, and the water restored to a wholesome state? Can you give any instances showing what distance of run in a river will suffice to purify water contaminated with a certain bulk of sewage? Admitting that exposure to sun and air during a run of a certain number of miles in a river will suffice to oxidise dead and decomposing matter, yet there is the hypothesis that *living* matter (*germinal matter*, shapeless organic matter, or germs, cells, or spores of fungi, ova of parasites, &c.) proceeding from diseased bodies may be conveyed by river water, and be the cause of disease. Have you any facts showing that disease of any sort has been propagated by such living matter, after a flow of a certain number of miles down a river? Of two towns on the same river—one above draining into it, the other below drinking from it—do you know any instances of disease propagated from the former to the latter through the medium of the river water? Do you know any facts

showing the propagation of typhoid, or scarlet fever, through potable water?

An adjourned meeting of the Association will be held on Saturday, May 1st, when the discussion will be resumed on Dr. Letheby's paper "On the Methods of Estimating Nitrogenous Matters in Potable Waters, and on the Value of the Expression '*Previous Sewage Contamination*' as used by the Registrar-General in his Monthly Reports of the Metropolitan Waters."

The chief points for consideration in the paper are the following:—1st. Whether rivers fouled by sewage and manufacturing refuse have or have not a self-purifying power. 2nd. Whether the nitrogenous compounds of river and well waters must necessarily have a previous sewage or manure origin. 3rd. Whether, in describing the analytical facts of water examinations, it is proper to use such a speculative phrase as "Previous Sewage Contamination," and to express the result in tons.

Royal Society.—At the President's second soirée, at the Royal Society, on April 24th, 1869, Mr John Browning, of the Minories, exhibited the following novel instruments:—

New Electric Lamp, in which both carbons are moved by the electricity without clockwork.

New Polarising Saccharometer, proposed by Dr. Dupré. This instrument shows the amount of sugar in a solution by a change in the position of a line in the spectrum.

An Improved Spectroscope, in which the dispersion may be instantly doubled or trebled, without changing any of the adjustments.

A new Direct Vision Pocket Spectroscope; containing seven prisms, and an achromatic lens. This instrument will show the absorption bands in coloured fluids, the bright lines in the spectra of metals and gases, and all the principal lines in the solar spectrum.

Professor Graham's discovery, the absorption of hydrogen by palladium; a very compact apparatus for showing the expansion of a piece of palladium by the absorption of the gas, contrived by Mr. Chandler Roberts and Mr. John Browning.

The Zirconia Light.—I learn that the oxyhydrogen zirconia light has been such a success at the Tuileries, having been worked without interruption since the 21st of January, that the Emperor has ordered measures to be taken to render that mode of illumination permanent in front of his palace. During the interval required for getting these new arrangements ready, the court will be lit up with ordinary gas as before. In connection with this fact, M. Tessiè du Mothay has had the Order of Chevalier of the Legion of Honour bestowed upon him, and well has he merited it for his many useful and practical inventions. Whether the process introduced by this gentleman for the commercial manufacture of oxygen from the manganates is the best that can be used for the purpose may, perhaps, be open to discussion; this, at any rate, is true, that it is the only process that has succeeded on a large practical scale up to the present time.—*British Journal of Photography.*

Laboratory of the London Institution.—We learn from the *British Medical Journal* that the Laboratory of the London Institution is about to be abolished. It is proposed to render the Institution more educational than heretofore; and, with this object in view, a class-room for giving elementary instruction in chemistry is to be substituted for the laboratory of research, which is at present occupied by Professor Wanklyn.

Chemical Prize.—The Chamber of Commerce of Nizza has the intention of awarding a premium of 15,000 francs (£600) to any one who discovers and invents a perfectly reliable and easily executed method of detecting an admixture of oil of grains (rape, linseed, poppyseed, &c.) with olive oil, when more than 5 per cent. are present. The process must be such as to be manageable by any one, and not entail difficult or dangerous operations, and, moreover, must be perfectly reliable. The committee of the Chamber of Commerce leave all details to the inventor, but will require him to satisfy them and any scientific or practical men they may wish to consult as to the perfection of the process. Communications to be addressed before the 30th of June next to the President of the Oil of Olives Committee of the Chamber of Commerce of Nizza, Alpes Maritimes, France.—*Ann de Chim. et Phys., March*, 1869.

Death of Professor Nickles.—We learn from a short notice of the *Moniteur Belge* of the 14th inst. that Professor Nickles of the Faculty of Sciences of Nancy, Département de la Meurthe, France, has died suddenly, in consequence of accidentally inhaling, as it appears, the vapour of concentrated hydrofluoric acid, while engaged in making experiments to isolate fluorine. The deceased was born at Erstein (Bas-Rhin) on the 30th of October, 1820, was appointed in 1854 to the Professorship he held, and in 1857 was made corresponding member of the Council General of Public Instruction. The printed list of his many and valuable published scientific works occupies a complete page in the well-known *Biographisch-Literarisches Handworterbuch zur Geschichte der exacten Wissenschaften.*

Gold Discovery in Uist.—According to rumours current in Shetland, the Lerwick correspondent of the *Scotsman* writes:—"It seems that gold has been discovered in Uist: it is said to exist in two localities, but whether it will pay for working has not been determined yet. There are two islands named Uist, one named North and the other South; both are situated off the Western Coast of Scotland's mainland, and belong to the Hebridean Group of Isles."

Atomic Weights.—We observe, and have read with great pleasure, a brief, but, at the same time, very clearly and highly finished paper on this subject in Spon's "Dictionary of Engineering." This paper, written, as it evidently is, by a highly accomplished scholar and mathematician, as well as scientific chemist, deserves not only to be read and used by engineers, but will undoubtedly prove very acceptable to many chemists, and especially to students of chemistry, who will find in about eight octavo pages the whole doctrine of Stoichiometry fully, clearly, and comprehensibly explained. The paper alluded to occurs in Nos. 6 and 7 of the work, each part of which may be had separately.

Applied Science in Italy.—We have to acknowledge the receipt of two small papers from M. Emile Kopp, viz., two printed copies of decrees of H. M. the King of Italy, officially published, one dated the 30th of December, 1866, the other the 14th of November, 1867. The former relates to a re-organisation of the Royal Italian Museum, which is a kind of polytechnical school and agricultural college combined. From the different schedules added to this degree, it appears that a very well selected and comprehensive course of lectures is ordered and intended to be given. The latter decree relates to the approval by His Majesty of the regulations made by the Italian Secretary of State for Public Instruction for the Royal School of Applied Science and Engineering at Turin. We have to confess that, looking over the *series lectionum*, nothing of this kind of instruction, or anything approaching to it, established by the State, is to be found in the United Kingdom. No doubt the Italians will, as we hope, highly appreciate the excellent opportunities given them, at a very trifling cost, to obtain that practical and scientific instruction they are highly in want of, in order to be enabled to fully develop the eminent natural resources of their beautiful country, once the chief seat and depository of learning, art, and science in the world.

On the Use of Tungstate of Baryta in Painting.—(Extract from a letter from M. Sace to M. Dumas.)—"At the request of a landscape painter, I was induced to examine in succession all our insoluble white compounds, with regard to their adaptability to painting purposes. Tungstate of baryta answers perfectly, covers as well as white-lead, and is as unalterable as zinc white. It has been employed by this artist for three months, and was found equally successful in oil or water colours, chromolithogra-

phy, and even in making white impressions on a black ground. This harmless substitute for the injurious white-lead is prepared on a large scale in Paris by M. E. Rousseau."

Extraction of Oxygen from the Air.—There is a competitor in the field now, in the shape of a process for extracting the oxygen from the air after the manner of the respiratory organs of animals. MM. Laire and Montmagnon propose to take advantage of the well-known property of wood charcoal, alkaline solutions, and blood of absorbing oxygen from the surrounding air, and condensing it between their molecules, either by a physical or chemical affinity. It is proved, by experiment, that 100 measures of wood charcoal, freshly burnt, absorb 985 of oxygen, and only about 705 of nitrogen. The blood of animals and solutions of phosphate and carbonate of soda absorb rapidly, according to the amount of surface exposed to the air, about 12 per cent of oxygen, and only two per cent of nitrogen. The proposed method of using these facts is this:—Pump out the oxygen and nitrogen from the substances used to absorb it by means of an air-pump; pass the mixture through fresh-absorbing *media in vacuo*; re-extract, and repeat the operations as often as required. In this way an oxygen is obtained very free from nitrogen, and at an extremely cheap rate. The reservoir which contains the charcoal, &c., may be compared to the lungs of animals, and the air-pump to the pulmonary apparatus of the same nature. If this process should succeed upon a commercial scale, it will be a beautiful example of the imitation of one of nature's great processes, and its adaptation to the wants of man.—*British Journal of Photography.*

Astronomical Clock for Beauvais Cathedral.—Although not exactly belonging to the subjects the pages of our paper are devoted to, we abstract from the French journal *Les Mondes*, the following:—The clock is destined to be placed within the cathedral church; it is a piece of furniture constructed according to the designs of the Rev. Father Piérart, S.J., 12 metres in height, 5 metres wide, and 2 metres deep; it contains fifty-five dial plates, and indicates eighty different things; the internal work contains 90,000 parts. The clock indicates the exact time for twenty different parts of the globe, indicates also the precise moment of the rising and setting, and meridian passage of the sun and moon at Beauvais for every day of the year, and, moreover, the rising and setting of no less than 10,000 stars for the same place; besides this, other things, as saints' days, &c. At present the clock is at Paris, and may be seen in the Palais de l'Industrie. The entire work is highly spoken of, both as work of applied science and of fine art. The clock has been made, it appears, at the desire and expense of Magyar Grignoux, Bishop of Beauvais.

Statue to Oersted.—We learn from *Cosmos* that a committee has been formed at Copenhagen with the intention of erecting a suitable monument in honour of the great Danish *savant*. A statue, representing the illustrious man, is ordered to be made by a Danish sculptor, named Ferichau, and is intended to be placed in a prominent situation in the capital of the kingdom.

Accident to Professor Bunsen.—The *Carlsruhe Gazette* relates that an accident the other day befell the celebrated chemist Bunsen. He had prepared a quantity of a composition recently discovered, and had dipped his fingers in the vessel, to see if the composition was dry, when that slight pressure sufficed to ignite the whole mass, and a flame arose, which scorched the experimentalist rather severely in the hands and face. He is expected, however, to recover in the course of ten days or a fortnight.

Mineral Caoutchouc.—Recent communications from Adelaide, South Australia, have made known the discovery in the southern portion of the colony of a remarkable carboniferous substance, which hitherto has only been found in small quantity in the coal strata of Derbyshire (England). It is a mineral caoutchouc, so called from its general appearance and elasticity. In Australia it is found on the surface of the sandy soil, through which it would appear to exude from beneath, as, burnt off occasionally by the bush fires, it is again found after the winter season, occurring in quantity and of varying thickness. Analysis proves it to yield 82 per cent or more of a pure hydrocarbon oil; its value for the manufacture of gas there will be great, and it is also believed to be applicable to the making of certain dyes. The discovery is also important from its indication of the existence of oils or other carboniferous deposits. This material, known in mineralogy as elaterite, is also found in a coal pit at Montrelais, near Nantes, France, at Neufchâtel, and on the island of Zante. According to the analyses of the late Professor Johnston, of Durham University, it is a hydrocarbon containing from 83·7 to 85·5 per cent of carbon, and from 12·5 to 13·28 per cent of hydrogen. The variety found in Derbyshire (near Castleton) has a specific gravity varying between 0·9053 to 1·233; the substance is highly inflammable, its colour blackish brown, its lustre resinous.—*Mining Journal.*

A Curious Laboratory.—We read in the *Lancet* that M. Sainte-Claire Déville, in connection with his scheme for substituting the mineral oils for coal as fuel in the French fleet, has undertaken a series of experiments, in which he will study the effects of pressure on various phenomena, and especially the causes of light in flame, of combustion, &c. In order to pursue these researches, it has been thought necessary to construct a large iron laboratory, capable of receiving the experimenter with all his apparatus, and which may be subjected to an extraordinary atmospheric pressure by means of suitable pumping apparatus. This iron safe has the form of a vast cylinder, surmounted by two chimneys, one serving to connect the pressure pumps, and the other to admit the operator and his apparatus. The experiments will be conducted by M. Sainte-Claire Déville and some other *savants*, and will involve a certain degree of danger. No doubt of this latter assertion; *queritur*, how their lungs and brain will feel under increased atmospheric pressure?

Ozonisation of Hydrocarbon Oils.—M. Grotowsky, of Halle on the Saale, has made known some interesting facts on a new property of various hydrocarbon oils, which he has discovered. Exposing various kinds of oils in glass flasks to the rays of the sun for a period of three months, he found invariably that they absorbed oxygen and converted it into ozone. The air was ozonised even in well-corked vessels, the effect being, however, to some degree dependent upon the colour of the glass. The respective results were noted after the lapse of three months, American kerosene, from petroleum which had been exposed to light in white uncovered glass balloons, had become so strongly ozonised that it scarcely burned. The originally bluish white oil had assumed a vivid yellow colour, and the specific gravity was found to have increased 0·005. American kerosene, which had been kept in the dark for three months, did not show any ozone at all, and burned satisfactorily. The oils were exposed from April to July, 1868; those which had become strongly ozonised had also suffered a distinct change in odour, and the corks were bleached as if attacked by chlorine, while the other oils had remained unchanged in these particulars. These results are fully confirmed by the experience of the consumers as well as of the dealers in these oils, who all avoid obtaining "old oils" as they call them. It appears that re-distillation, with quick-lime and clean iron nails, restores the oils to their original state and properties.—*Engineer.*

The Chemical Society, wishing to honour the memory of its late distinguished Fellow Professor Faraday, and at the same time to promote the personal intercourse of the Society with eminent foreign chemists has decided upon instituting a Faraday Medal, to be awarded, from time

time, to some foreign chemist of distinction, upon his cepting the invitation of the President and Council of e Chemical Society to deliver a lecture to its Fellows. ie inaugural lecture will be delivered on June 17th by Dumas, Master of the French Mint, a personal friend Professor Faraday's, and well known to chemists all er the world as the author of many important investiga- ns in organic chemistry, and especially as the introducer the doctrine of chlorine substitutions. By permission the managers, M. Dumas's lecture will be delivered in e Theatre of the Royal Institution, associated for so any years with Professor Faraday's own expositions. ie Fellows of the Society and their friends will dine gether at Willis's rooms on June 18th, on which occasion Dumas is expected to be present as a guest.

Depth of some Recently Bored Wells.—As an ident proof of the greatly advanced desire to procure for mestic purposes good and pure water and a plentiful sup- y thereof, it is interesting to learn that within the last five ars the undermentioned wells have been bored, some of em at very great expense. At Antwerp, to a depth of 5 metres below the surface; at Ostend, 300 metres; at ynhausen, Prussia, 696 metres; at Mondorff, Grand Duchy Luxemburg, 730 metres; at Passy, Paris, 624 metres; Rochefort, Charente Inférieure, France, 816 metres (this the deepest bored well now existing in Europe). At Gris- , Soerabaya, Java, a well has been bored to a depth of metres through hard rock. The deepest boring in Hol- d has been carried to a depth of 182 metres below sea el at Gorkum, at which depth in that locality, the tertiary mation has been reached, but water only of very indiffe- nt quality; with this exception all the above-named wells ld water in abundance, and of great purity.

Quantitative Estimation of Sulphocyanides.—ording to experiments instituted by Dr. Rüdorff, the es- ation of the aforenamed salts, when neutral and soluble water, is perfectly reliable when executed by means of ation with a neutral soluble silver salt. Experiments de by the author with properly recrystallised sulphocya- es of ammonium and potassium yielded exactly the theo- eal quantity; the salts experimented with had been pu- d by recrystallisation from alcohol and afterwards dry- —*Poggendorff's Annalen.*

Westphalian Iron Pyrites.—At the Paris Exhibition 1867, there was a single block of pyrites from the Sicilian ites Company, in Westphalia, weighing 4500 kilos. This e was sent from the neighbourhood of Altenhunden-on- Lenne, and the mine yields now yearly 100,000,000 kilos his ore, which, according to an analysis made by Dr. senius, contains from 42 to 45 per cent of sulphur, from to 58 per cent of iron, and 0·02 per cent of arsenic. an average, about 43 per cent of sulphur in this ore is ilable for making sulphuric acid.—*Bul. de la Soc. d'En- agement.*

PATENTS.

municated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

3. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in manufacture of ice and of the agents employed therein, and in the ratus connected therewith."—A communication from C. Tellier, .—Petition recorded February 6, 1869.

3. J. Dewar, M.D., Kirkcaldy, Fifeshire, "Improvements in ing certain substances for food and for manure."—April 9, 1869.

3. E. C. C. Stanford Glasgow, N.B., "Improvements in applying, ing, and utilising materials for deodorising solid, liquid, and gase- matters."—April 10, 1869.

1. W. Wright, Mostyn, Flint, "Improvements in treating ores ain copper and other metals therefrom."—April 14, 1869.

1197. H. Aitken, Falkirk, N.B., "Improvements in treating iron ores or iron stones."—April 19, 1869.

1203. A. Brady, Stratford, Essex, "Producing pure iron direct from crude iron ore."—A communication from E. Brady, Philadelphia, Penn., U.S.A.—April 20, 1869.

1224. M. Henry, Fleet Street, London, "An improved mode of obtaining pyro-phosphate of lime."—A communication from E. Deligny Boulevard Saint Martin, Paris.

1227. C. D. Abel, Southampton Buildings, Chancery Lane, "A new or improved method of, and materials for the preparation of mural paintings."—A communication from P. Oury and P. Cousin, Rue de Trois Freres, Paris.—April 21, 1869.

1244. A. Borgnet, Swansea, South Wales, "Improvements in the manufacture of paint."—April 22, 1869.

982. J. C. Lee, Ashton-on-Mersey, Cheshire, "Certain methods of collecting excreta, and of treating the same in order to render them comparatively innocuous, and to obtain a useful product or useful products therefrom."—Petition recorded April 1, 1869.

1256. H. E. Newton, Chancery Lane, "Improvements in puddling iron."—A communication from C. Hewitt, Trenton, New Jersey, U.S.A.—April 23, 1869.

1278. T. Forster and P. B. Cow, jun., Streatham, "Improvements in compounds containing india-rubber, gutta-percha, or balata, and in the manufacture of such compounds."—April 24, 1869.

1317. A. Meredith, Newgate Street, London, "Improvements in the manufacture of iron and steel."—April 28, 1869.

1143. P. A. Blake, Highbury, Middlesex, "An improved safety explosive compound, and the apparatus connected with its use."—Petition recorded April 14, 1869.

1193. J. Horsley, Cheltenham, Gloucestershire, "Improvements in the manufacture of blasting powder or explosive compounds."—April 19, 1869.

1260. J. Major, W. Wright, Swallow Street, Middlesex, and G. H. Jones, Alpha Road, Middlesex, "A new or improved manufacture of white-lead, and apparatus employed therein."—April 24, 1869.

1361. P. Southern, Top Lock, Aspull, near Wigan, Lancashire, "Improvements in furnaces"—May 3, 1869.

1380. W. MacKean, Paisley, Renfrewshire, "Improvements in the manufacture of cattle food."

1381. E. H. Richmond, King William Street, London, "Improved apparatus and process for preserving fresh meat and other animal food, fish, poultry, and game; also ingredients, matters, or substances to be used in combination with the said apparatus."

1383. H. Highton, M. A., Brighton, Sussex, "Improvements in making, hardening, and preserving artificial stone, and in preserving the surfaces of walls and other surfaces."

1388 T. Welton, Grafton Street, Fitzroy Square, Middlesex, "A new method of applying oxygenated and other gas-charged charcoal, for curative and other purposes."—May 5, 1869.

INVENTIONS PROTECTED FOR SIX MONTHS BY THE DEPOSIT OF A COMPLETE SPECIFICATION.

1290. S. Oakman, Boston, Mass., U.S.A., "Improvements in the construction of smelting and other furnaces"—Petition recorded April 26, 1869.

NOTICES TO PROCEED.

3837. G. Hadfield, Lancaster, "Improvements in the manufacture of varnish."—Petition recorded December 17, 1868.

3830. C. Lichermann and C. Graebe, Berlin, Prussia, "Improvements in preparing colouring matters."—December 18, 1868.

3870. P. Spence, Newton Heath, near Manchester, "Improvements in the manufacture of alum and aluminous salts."—December 19, 1868.

3893. W. E. Gedge, Wellington Street, Strand, Middlesex, "A novel bituminous composition."—A communication from F. Labat and J. Meric, Boulevard Bonne-Nouvelle, Pari.—December 21, 1868.

375. C. D. J. Seitz, Bury, Lancashire, "Improvements in the construction of furnaces and pans for the recovery of the soda from the waste lyes resulting from the boiling of esparto grass, straw, or other fibrous substances, in the working and incinerating of the residue resulting from evaporation."—February 6 1869.

600. J. Townsend, Glasgow, N.B., "Improvements in extracting and in refining oils and other products from mineral and other materials containing carbon and hydrogen, and in apparatus therefor."—February 26, 1869.

969. G. Wells, Westminster, "Improvements in separating copper and bismuth from ores containing metals either separately or combined with other metals."—A communication from T. Y. Cotter and C. L. Dubois, Ade'aide, Australia.—March 31, 1869.

3930. W. H. Walenn, Tufnell Park, West Holloway, Middlesex, "Improvements in the electric deposition of copper and brass."—Petition recorded December 24, 1868.

3967. S. F. Healey, Pimlico, Middlesex, "Improved means of operating upon stick or gum lac, for the extraction of colouring matter or lac dye, and for the production of shell-lac."—December 30, 1868.

4. W. M. Williams, Sheffield, "Improvements in fettling or lining puddling furnaces used in the manufacture of iron and steel."—January 1, 1869.

164. A. M. Clark, Chancery Lane, "Improvements in the manufacture and refining of sugar."—A communication from L. J. F. Marguerritte, Boulevmt St. Martin, Paris.—January 18, 1869.

1178. G. T. Bousfield, Brixton, Surrey, "Improvements in the manufacture of heavy hydrocarbon oils, and in apparatus used therein."—A communication from J. Merrill, Boston, Mass., U.S.A.—April 16, 1869.

3945. E. Butterworth, Calder Cottage, near Rochdale, Lancashire, "Certain improvements in or applicable to furnaces."—Petition recorded December 26, 1868.

[English Edition, Vol. XIX., No. 496, pages 272, 270, 268; No. 492, page 227; No. 493, pages 238, 239; No. 495, page 263.]

3965. A. G. Cazalet, Rue Gaillon, Paris, "Improvements in the manufacture of steel, and in the apparatus employed therein."—December 30, 1868.

26. W. Prosser, Lancaster, "Improvements in the purification and bleaching of oils, gums, and resins and spirits."—January 5, 1869.

905. J. J. Bodmer, Newport, Monmouthshire, "Improvements in the manufacture of iron and steel, and in the apparatus to be employed therein, part of which improvements are also applicable to the treatment of other metals and alloys."—March 25, 1869.

1083. J. Dewar, Kirkcaldy, Fifeshire, "Improvements in treating certain substances for food and for manure."—April 9, 1869.

NOTES AND QUERIES.

Chemical Infinity.—Appleton's Journal contains in its first number a calculation by Berthelot, the eminent French chemist, of the number of combinations which may be made of acids with certain alcohols. He says, if you give each compound thus possible a name, and allow a line for each name, and then print 100 lines on a page, and make volumes of 1000 pages, and place a million volumes in a library, you would want 14,000 libraries to complete your catalogue.

The Gulf Stream.—Captain Maury considers the Gulf Stream equal to a stream 32 miles broad and 1200 feet deep, flowing at a rate of 5 knots (38,415 feet) an hour. This gives 6,166,700,000,000 cubic feet per hour as the quantity of water conveyed by this stream. Sir John Herschel's estimation is still greater; he considers it equal to a stream 30 miles broad and 2200 feet deep, flowing at the rate of 4 miles an hour; this makes the quantity 7,359,900,000,000 cubic feet per hour. Sir John estimates the temperature of the water at 86° F.—*Engineer*.

Carbonic Acid.—Mr. Kernan evidently forgets that common washing soda contains—(1) more than half its weight of water of crystallisation, and (2), unless purposely purified, is contaminated with some undecomposed chloride of sodium and sulphate of soda, containing, moreover, caustic soda; the substance being, moreover, soluble in water, is not so well adapted also on economical grounds for the production of carbonic acid gas as is white marble, or any other lime-stone, which, weight for weight, will yield more gas than the common washing soda. Of course it may be used, but it has no advantage.—Dr. A.

An Excellent Indelible Ink may be prepared by rubbing up 1 drachm of aniline black with a mixture of 60 drops of concentrated hydrochloric acid and 1½ ounces of alcohol. The resulting deep blue liquid is then to be diluted with a hot solution of 1½ drachms of gum-arabic in 6 ounces of water. This ink does not corrode a steel pen, and is affected neither by concentrated mineral acids nor by strong lye. If the aniline black solution be diluted with 1½ ounces of shellac, dissolved in 6 ounces of alcohol, instead of with the gum-water, an aniline black is obtained, which, after being applied to wood, brass, or leather, is remarkable for its extraordinary deep black colour.—*American Artisan*.

Supply of Water for Domestic Purposes.—From a brief report of the proceedings of the Municipal Council of Nismes, France, we copy the following figures, indicating the quantity of potable water supplied daily in litres to the under-mentioned places for each head of inhabitants

		litres.
	Ancient Rome	1500
	Rome of present day	900
	New York	360
France.	Carcassonne	400
France.	Besançon	270
France.	Dyon	270
France.	Bordeaux	170
	Paris, at present	125
	" in 1871	250
	London	95
	Lyons	85
	Brussels	80
	Genève	74
	Nismes	200

Action of Heat on Peroxide Salts of Iron.—The observation of M. Debray, reported in your last issue (*Am. Repr., June*, 1869), on the action of heat upon the peroxide salts of iron, explains a matter that I have almost invariably noticed for several years past, in testing commercial sulphate of soda, or salt-cake. As manufactured on the large scale, this substance always contains a small amount (from 0·25 to 0·5 per cent) of the sulphate of peroxide of iron, and, when dissolved in cold water, forms a colourless solution, even when concentrated. If hot water be used, or if the cold solution be gradually heated, it immediately becomes quite brown-coloured, and particles of hydrated peroxide of iron are observable, the static equilibrium having been in this case disturbed by the sulphate of soda present.—Bristowe.

"*How to Prevent the Spread of Scarlet Fever.*"—As far as it has been possible to ascertain, the miasma of scarlet fever, *febris scarlatina maligna*, is a fixed contagium, not volatile, nor to be met with at a distance from the patient who, while suffering from the disease, produces the peculiar miasma, about the real nature of which, be it a germ, or something else, nothing is precisely known; it is, however, a fact that keeping disinfectants in the locality where a patient suffering from the disease is confined, is beneficial as a prophylactic for those attending upon him. Green copperas, sulphate of protoxide of iron, would not be so fit to use in this special case as sulphurous acid, hypochlorite of lime, or carbolic acid. Green copperas may disinfect drains and cesspits, but would be of little avail in this particular case, the less so as the evident proof has not been given that scarlatina is propagated in the way spoken of by "Sanitas." This discussion should rest here, as it is not one to which the columns of this paper are open, being a purely medical subject.

On the Cause of a Pink Colour in White Lead Corrosions.—It appears, from the experiments of Mr. W. Baker (*Phil. Mag.*, May, 1869), that not, as he formerly supposed, oxide of copper, but metallic silver, when present in lead in small quantity, is the cause of the pink colour now and then observed by white lead manufacturers. Analysis of 5,000 grs. of white corrosion gave:—CuO, 0·0050; FeO, 0·0022; NiO, traces; Ag, 0·005, per cent. Pink corrosion:—CuO, 0·0060; FeO, 0·0022; NiO, 0·0013; Ag, 0·0058 per cent. A decided colour, which is uniform throughout the mass of the corrosion, is obtained when the silver amounts to about 1½ ozs. per ton. The author ascertained that the silver is present in metallic, but of course finely divided, state.

Discovery of Natural Gas.—Some workmen, while boring for water at Middleton Hall, Uphall, Linlithgowshire, observed that gas escaped from the bore-hole. They applied a light, and instantly the gas blazed up in a beautiful white light, and continued to burn with increasing force, until it was extinguished by the workmen in order to resume their boring operations. The stratum from which the gas evolves is well known to mineralogists as the marl which overlies the rich bituminous shales of this district. Judging from the extent of the source of supply, and the richness of the gas, it might be profitably employed for heating and illuminating purposes, and the shale worked for oil making. The parish of Uphall is contiguous to Bathgate, well known for the Boghead coal being found in its neighbourhood.

Mutual Decomposition.—In the employment of common reagents in an aqueous analysis, it is usual for the test employed and the substance sought, if present, to mutually decompose each other, and to form salts of a different nature—for example, the determination of sulphuric acid in a soluble sulphate by means of a soluble salt of barium; the acids in this case are transposed, because of the stronger affinity of the acid of the first base for the base of the second. But in the dry way it frequently happens that, at an elevated temperature, acids and bases lose the stronger affinity, and combine with other bases and acids, for which at ordinary temperatures they have a lesser affinity—for example, sulphate of baryta and carbonated alkali. Now, in the case of a mixture of sulphate of lime and carbonate of magnesia, I had no standard chemical work for reference to ascertain whether, on application of heat, these salts undergo decomposition—carbonate of lime and sulphate of magnesia resulting, or more probably caustic lime and sulphate of magnesia, as such was my impression; hence my note appearing in your issue of the 23rd ult. I am obliged for your answer of last week, but thinking so an apparently simple matter—as to whether these salts do or do not decompose at a high temperature, say a red heat—must be well known to those skilled in chemistry, is my excuse for again writing.—W.

Purifying Water.—(Report of the Netherlands Committee.)—It is a well-known and generally observed fact that the water of rivers, canals, and some lakes is never quite clear. This turbidity, which often remains even after many days of quiet rest, is partly due to inorganic substances floating about in the water and suspended therein, but is far more frequently caused by matters of an organic nature too minutely divided and too small to be readily recognised, even by a powerful microscope. The researches of some of the members of this report have undeniably proved that, at least as far as the Netherland waters they submitted to research are concerned, this turbidity is due to extremely minutely divided clay, by the aid of which a great deal more of organic matter than could otherwise remain suspended is kept in such an extreme state of division as to pass through filters and not deposit, even after many days of rest. When, to such kinds of water, a solution of alum (from 1-50,000th to 1-100,000th of the bulk of the water) is added, it will be observed that after a longer or shorter lapse of time a flocculent precipitate is formed, which is either alumina or a basic sulphate thereof, which flocculent material takes up all the turbidity of the water, leaving that perfectly clear; the precipitate thus formed has been submitted to chemical tests, and it was found to contain a large quantity of organic matter, and to yield, on being heated with soda-lime, ammonia very largely. Since the committee was instructed to ascertain and discover the means of improving the condition of the potable waters where it was required, this especially also applied to the towns and villages whose chief supply of water for domestic and drinking purposes depends upon that of the river Maas, along the banks of which, in the lower portion of its seaward course, the population is entirely dependent upon its water; which has been almost from time immemorial known to produce, in those not accustomed to its daily use, a diarrhœa, which in certain individuals is accompanied by very unpleasant, if not always, therefore, dangerous symptoms. The water of this river has been analysed over and over again by many eminent scientific chemists, and has been submitted to microscopic research, but no trouble, nor anything science could, armed with its best weapons, bring to bear on this research, has ever revealed the precise cause of this peculiar property, which is not possessed by the water of the same river, nor also by that of the Rhine, higher up its course. For curiosity's sake, we here quote the result of one of the most recent analyses of this water taken at flood tide at Rotterdam:—Physical properties—very turbid, does not become clear on standing, is not rendered clear on addition of a few drops of hydrochloric acid; taste—not quite unpalatable; solid residue—dried at 120° C., yielded, for 1 litre, 0·195 grm., containing 0·055 of combustible matter; earthy salts—0·0975 grm., containing 0·048 sulphate of lime, chlorides of alkalies, 0·0233; ammonia—none; slight trace of nitrates; dry residue had a yellow colour before ignition. It is a highly important fact, and one of very general importance to learn, that Dr. J. W. Gunning, of Amsterdam, has found that the perchloride of iron added to this water (and the same applies to far more foul waters experimented upon) has the effect of rendering it perfectly wholesome and even agreeable for use. To one litre of water, 0·032 grm. of the dry salt just alluded to, and previously dissolved in pure water, are added,

and, after well stirring the liquid, it is left quietly standing, to settle, for fully thirty-six hours. A series of very carefully made experiments has proved that no free hydrochloric acid (the quantity thereof contained in the above-stated weight of perchloride of iron only amounts to 0·021 grm.) was left in the clarified and purified water, but in order to suit the application on the large scale, and to make assurance doubly sure, as regards any acid or perchloride being left undecomposed, or rather uncombined, with the organic and inorganic matter of the water, Dr. Gunning has advised that a small, but equivalent, quantity of crystallised carbonate of soda should be also added some hours previous to beginning to take the purified water for use. At Dr. Gunning's request, a scientific gentleman of high attainments, who happens to have an excellent opportunity, near Rotterdam, to try on the large scale this process, has submitted it to practical test, and a quantity of no less than about 240,000 litres of Maas water, taken at all times of the year, has been treated by this process, and thereby rendered perfectly fit for use, and consumed by various parties, has proved to have been entirely deprived of its property of causing diarrhœa; moreover, the medical officer in charge of the crew of Her Majesty's corvette the Lynx, moored off Rotterdam, in the river, has applied this process to the water taken from the river, and found by experience that the thus purified water has even the good effect of restoring to health such of the crew as had been incautiously drinking the not previously purified Maas water. It is, when using this means of purifying bad water, of great importance to let the sediment quietly settle; it occupies about 4 per cent of the bulk of the water, which on the large scale will, for security's sake, be submitted to a filtration through fine well-cleansed sea-sand before being sent through the mains of the large waterworks intended to be established near Rotterdam for the supply of that town. The quantity of crystallised carbonate of soda which is equivalent to 0·032 grm. of dry perchloride of iron is 0·085 grm.; both these quantities are the maximum required to render the Maas water perfectly pure, even at the time when it is most turbid; comparative experiments have conclusively proved that the application of this process is very superior to filtration of the water, even through animal charcoal. The result obtained with the Maas water having been so eminently successful, the committee has applied this method to the purifying of water otherwise non-drinkable, such as is met with in many of the smaller canals, brooks, and also pumps yielding surface water of bad quality in many parts of the kingdom, and the results obtained are such as to justify the order that this method of purifying must be applied by authority to a class of waters which, thus treated, become available for use. The precipitate formed by the addition of the perchloride of iron and carbonate of soda, both previously dissolved, has been proved, by accurate analysis, to contain a large quantity of organic matter, which, on being ignited with soda-lime, yielded ammonia very largely; analysis has also proved that, as regards the Maas water, the only addition to its inorganic constituents is that of one part of chloride of sodium, by weight, in 40,000 parts of water by the application of this process. Dr. Gunning has found that the effect of the perchloride is not so conspicuous with some well waters containing much carbonic acid; while, moreover, there may exist in some of these kinds of waters, either in quantity or quality, inorganic salts which delay or altogether impede the peculiar mode of flocculent precipitation observed with the above-named Maas and other waters to take place after addition of the iron salt.

Cryolite.—We should be glad to know of a firm who are sellers of cryolite or Greenland spar.—J. B. and Co.

Sulphate of Manganese.—What is the annual consumption of sulphate of manganese, its price per ton, and what it is principally used for, and who are the principal buyers of it?—Wm. Blench.

Bread for Diabetes.—Can any of your courteous readers supply me with information respecting the manufacture of the bread which is prescribed in the treatment of diabetes?—Farina.

Alizarine.—Is MM. Graebe and Liebermann's discovery (the artificial preparation of alizarine) likely to be of any commercial value? Madder alizarine of commerce being extracted and sold profitably at less than £10 per cwt.—B. S.

Soldering without Fire.—Information wanted concerning the brazing or hard soldering of copper without fire, and merely by the application of a preparation made for the purpose, quite independent of any galvanic arrangement.—Fluorine.

Carbonic Acid.—Referring to the query of Mr. E. Kernan in your number of April 30th (*Am. Repr., June*, 1869, *page* 336), and referred to by Dr. A. in that of May 7th (*Am. Repr., July*, 1869, *page* 50), may I venture to suggest that native carbonate of barium would be a more economical source of carbonic acid than the substance named? When treated with muriatic acid, chloride of barium is formed, and the carbonic acid gas is given off very freely. If sulphuric acid be added to the barytic salt which is in solution, sulphate of barium will, of course, be precipitated, and pure hydrochloric acid recovered. The price of the carbonate of barium is 7s. per cwt.—Fredk Braby.

On the Characteristic Differences and Tests for the Detection of some Fatty Oils.—Dr. Sacc, of Neufchâtel.—*Castor Oil.* Nearly colourless, very viscous, faint odour; becomes more fluid on being heated; becomes bright orange coloured in contact with nitric acid. The oil does not develope much heat when brought into contact with sulphuric acid; its colour becomes thereby cinnamon-brown. When the mixture is put into water it forms a mass at first insoluble, which, however, becomes gradually decomposed, the oil floating on the top evidently having undergone little or no change at all. Acetic acid does not act upon the oil at all; soda forms an emulsion to some extent with the oil, but fails to effect this completely; alcohol dissolves some of the oil. With solution of nut-galls, a portion of the oil is converted into an emulsion; liquid ammonia is without action; with nitrate of silver a yellow colouration appears at the point of contact; chloride of gold gives rise to the formation of an emulsion, and is itself partly reduced to metal. *Linseed Oil* (*Raw*).—Colour deep yellow; odour acrid; when heated, its colour becomes more pale, and the oil foams strongly; with nitric acid, olive-coloured tinge. Concentrated sulphuric acid causes much disengagement of heat, and the colour of the oil becomes dark brown; the mixture swells considerably; sulphurous acid is developed as well as formic acid. The residue is insoluble in water, and gives off the smell of asphalt; acetic acid, no action; with caustic soda solution, yellow emulsion; to a small extent soluble in alcohol. With solution of nut-galls the oil becomes solidified, forming a solid yellow-coloured mass; liquid ammonia causes it to form an emulsion. No action with nitrate of silver; chloride of gold is readily and completely reduced to the metallic state when in contact with this oil. *Poppy-Seed Oil.*—Colour bright yellow; no perceptible smell; no change on being heated; no action with nitric acid. With sulphuric acid very little heat is developed, and the oil is changed into a cinnamon-brown coloured magma insoluble in water. Becomes slightly turbid with acetic acid; forms a white emulsion with soda; not soluble in alcohol, which latter fluid floats on the oil; becomes slightly turbid with solution of nut-galls; forms a white emulsion with liquid ammonia. With solution of nitrate of silver a white emulsion is produced, only, however, at the point of contact between the oil and the solution; with chloride of gold a trace of reduction to the metallic state takes place. From these experiments we learn—(1) that nitric acid only produces a colour with ground-nut, cotton-seed, sesame-seed, castor, linseed, nut, and whale oils; (2) that sulphuric acid combines with all the oils, thereby producing compounds soluble in water in the case of olive, colza, ground-nut, cotton-seed, and sesame-seed oils; (3) that the solution of nut-galls is without action upon olive, nut, and whale oils, that all the others are made into emulsions, and that linseed oil is coagulated by the said solution; (4) that caustic soda solution forms emulsions with all the oils except that of cotton-seed, the castor oil, and nut oil; (5) that nitrate of silver becomes blackened only when in contact with colza oil; (6) that chloride of gold forms emulsions with all the oils and is in contact with all reduced to metal, excepting in the case of olive and colza oils; with the former of these and the reagent alluded to, no reaction takes place at all, and with the latter an emulsion is only formed, no reduction taking place.—*Rev. Hebd. d. Chim.*, No. 23, 1869.

On the Estimation of the Iodine of Commerce by Volumetrical Analysis.—M. Bobierre dissolves a weighed quantity of the iodine, the true value of which has to be estimated, in a concentrated solution of iodide of potassium, the solution is diluted to 100 c.c., and is dropped into an alkaline solution of arsenious acid of known strength. Instead of using starch water, as a means of recognising the end of the reaction, the author adds a few cubic centimetres of benzol to the solution of arsenious acid, and ceases to add more of the solution of iodine as soon as the former solution becomes rose-coloured. The arsenical solution is made by weighing off 49·95 grms. of arsenious acid and 14·5 grms. of crystallised carbonate of soda, and dissolving these in 1 litre of water, representing 12·688 grms. of iodine to the litre; 10 c.c. of this solution are taken for each assay, and 4 c.c. of benzol are added.—*J. de Pharmacie.*

Alizarine.—It is as yet impossible to answer this question, since Messrs. Graebe and Liebermann do not manufacture on a sufficiently large scale to judge of the commercial success of their process.—F.

Bread for Diabetes.—Bread composed of gluten of wheat without starch, or bran-cakes baked with eggs, have been recommended. It is very likely that some of the higher-class bakers of the West End shops keep, or at least, if required, make, bread of this kind, as is the case in Paris.—H. C. S.

Bread for Diabetes.—Take coarse wheat-bran, wash it with water on a sieve until the water passes through clear, dry it in an oven, and grind to a fine powder by a mill. Take seven eggs, 1 pint of milk, ½lb. of butter, a few caraways or some powdered ginger, and make the whole into a paste with a sufficiency of the bran-flour. Divide the mass into seven equal parts, and bake each separately in a saucer by rather a quick oven; time about twenty minutes. Another way is to take potatoes, 4 lbs.; rasp them, and wash on a sieve as above; 3 ozs. mutton suet, three eggs, 2 ozs. butter, 1 drachm carbonate of soda; mix, and add ½ fluid oz. pure *dilute* hydrochloric acid Lond. Pharm. Divide into two cakes, and bake immediately in a quick oven until nicely browned.—G. A. K.

Sulphate of Manganese.—This substance is not used in the arts or manufactures to any extent; those who want it (as for instance calico-printers) either make it themselves or purchase it from manufacturing chemists, who only make it in any quantity when ordered; as to its price, any price-list of wholesale firms will give information.—L.

Carbonic Acid.—Carbonate of barium is by no means a mineral found in such quantities as to render it particularly adapted to the manufacture of carbonic acid on account of cheapness as compared with white marble, thousands upon thousands of tons of which, in the shape of chips, are burned for lime; and whilst, in small quantities, at stone-masons' and marble-work yards, may be had almost for the mere trouble of picking them up.—A.

Magnesian Cement.—I have been trying the magnesian cement—an oxychloride of magnesium—discovered by M. Sorel, of Paris, and am struck with its cementive powers, even when mixed with much foreign matter. An invention apparently so excellent can hardly have been allowed to remain unnoticed without some reason. Are its hydraulic properties deficient? Are the materials too expensive for application on a large scale?—R.

Black Ink from Elder Berries.—The bruised berries are placed in an earthen vessel, and kept in a warm place for three days, then pressed out and filtered. The filtered juice is of such an intense dark colour that it takes 200 parts of water to reduce it to the shade of dark red wine. Add to 12½ quarts of this filtered juice 1 oz. of sulphate of iron and the same quantity of crude pyroligneous acid; and an ink is prepared which, when first used, has a violet colour, but when dry is indigo-blue black. This ink is superior in many respects to that prepared with

galls; it does not become thick so soon, it flows easier from the pen without gumming, and, in writing, the letters do not run into one another.—*Deutsche Ind. Zeitung.*

Oxychlorides.—The white precipitate given by $BiCl_3$ in water is called an *oxychloride* by certain chemical writers (Bence Jones, H. Watts), whilst that given by $SbCl_3$ is called a compound of the trioxide and trichloride. Is not the one as much a compound of the trioxide, &c., as the other? Chemistry aims at being exact, and certainly needs it. Why not be exact in minor matters if possible? Could the first be given as in the following equation;—

$$3(BiCl_3)+3(H_2O)=BiCl_3+Bi_2O_3+6HCl,$$

and the second—

$$3(SbCl_3)+3(H_2O)=SbCl_3+Sb_2O_3+6HCl,$$

or could not both terms be got quit of, and these precipitates be classified under the basic salts?—John D. Macdonald, Urquhart, Inverness.

Wood Pulp.—According to M Ouvli, who has thoroughly investigated this subject, excellent results are obtained when for a hundredweight of wood pulp from 400 to 800 grms. of oxalic acid are used; this acid has the double advantage of bleaching the colouring matter already oxidised, and of neutralising the alkaline principles which favour such oxidation. He adds to the oxalic acid one pound, or a little more, of sulphate of alumina (not alum) entirely deprived of iron. The principal agent in this mode of bleaching is the oxalic acid, the power of which over vege able colouring matter is well known; the sulphate of alumina has no bleaching power of its own, but it forms with the colouring matter of the wood an almost colourless lake, which has the effect of increasing the brilliancy of the pulp. Chlorine, chloride of lime, and any other mineral acids are decidedly injurious in the bleaching of all matters of this kind and always leave a more or less deep yellow tinge.

Naphthaline Colours.—The discovery of fuchsine, and other colours derived from aniline, first caused the existence of very rich sources of colouring matters to be predicted in mineral oils and carburet of hydrogen in general. Therefore, since that period, chemists have devoted themselves to laborious researches in the same direction, in order to find new dyeing products. The method which M. Clavel has adopted was suggested by the study of the circumstances which have since been explained respecting the formation of fuchsine. It is now, in fact, known that commercial aniline is a mixture of aniline and toluidine, and M. Hofmann has proved that it is a mixture of these two bases that produces the brilliant colour. Guided by the examination of these facts, M. Clavel has not sought in naphthylamine for a colouring matter by itself, but one likely to produce the colour by a mixture with another base, like naphthylamine, which has served to produce it, or with any other isomeric substance. The new colouring matter, then, is obtained by the direct oxidation of a product isomeric with naphthylamine, which is procured by distilling crude naph hylamine, produced by the reduction of nitro-naphthaline, and taking the products of higher distillation to mix with the naphthylamine. The dye obtained differs entirely from the colours extracted up to the present time from naphthylamine. We will describe, in a few words, the mode of operation:—The naphthaline being first treated with nitric acid of 1·33°, the resulting nitronaphthaline is washed, and reduced, either by iron and acetic acid, or zinc and hydrochloric acid, or any other analogous means, so as to obtain a sufficient reduction; this reduction being made, distillation is proceeded with. In the first place, naphthylamine passes; the condensation is then easier; the fire is increased, and it is then that the second body, discovered by M. Clavel, presents itself. This body constitutes the generating matter; it is treated at 120° with 50 per cent of very dry nitrate of mercury; a quantity of naphthylamine, equal to the quantity of the body used, is then added, and left in contact for about a quarter of an hour; the mixture is then treated with boiling water containing a vegetable acid; the colouring matter is dissolved, and filtered to separate the crude matters. The solution thus obtained may be treated according to the ordinary methods, for instance, by means of a salt, the colouring matter will be separated from it; this dissolved in alcohol gives a red colour of a magnificent tone, finer and more solid than the colours now extracted from naphthaline and naphthylamine; it presents by itself on the threads or tissues of silk, tints with brilliant reflection, warmer and of a clear effect. Hitherto the nature of the body discovered has not yet been specified by the author; he is waiting to give the analysis and chemical composition of it; but we can already give the principal characters of the new product. This body, which passes at the higher distillation, distils at a temperature of about 300°; its vapours form, in condensing, a deposit which rapidly becomes brown on exposure to the air. In a state of purity it is solid below 15°; it has then a viscous appearance, similar to the consistence of butter; it becomes more liquid at a higher temperature.—*Moniteur Scientifique.*

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

*** We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the Chemical News, and consequent pressure on our space, we are often obliged to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

W.—The treatise mentioned by you on water analysis is excellent; you can, if so inclined, purchase from Messrs. Griffin all the apparatus and test liquids, ready made, adapted for use according to the directions of this book. As to sewage, there does not exist any special treatise on the analysis thereof, but in Fresenius's and Noad's works on "Quantitative Analysis" you will find every information you may require to enable you to analyse what you desire. Your letter will appear next week.

A Subscriber since January.—Mr. Little's letter "On the Estimation of Phosphates," in No. 434 of the Chemical News (*Am. Repr., May*, 1868, *page* 246), will probably give the information you require.

W. J. Morgan.—You will find a good chapter on the use of the spectroscope in the last edition of Fresenius's "Quantitative Analysis." A book on the subject will shortly be published by Macmillan.

Tincture.—If you intend to sell it as a proprietary medicine it will certainly require the medicine stamp. By sending particulars to the Board of Inland Revenue, Somerset House, you will receive full information on the subject.

E. K.—The description of the apparatus is received, with thanks; we are always glad to have notes of novelties or improved apparatus. The yellow, red, and green lines, shown by sodium, lithium, and thallium in the spectrum microscope are true lines, not bands. A band is not generally sharp at the edges, and is wider than the image of the slit. Your difficulty is probably more apparent than real, still we should like to see Father Secchi's answer to your question. The description of the battery was too complicated, and required too many cuts to enable it to be given in our pages; it was, however, of no use to one or two correspondents. Hofmann's report on the aniline colours at the Paris Exhibition is given as a supplement to the English edition of Reimann's "Aniline." The book can be obtained at our office.

E. C. C. S.—The paper as last sent will be inserted next week; the second paper will follow.

Paper's questions cannot be answered without going into details, which must be fully discussed. A letter is waiting for him at our office.

M. P. Muir.—The process was fully described at the Chemical Society last session.

J. Lee, who enquires about aniline black, is referred to our Notes and Queries column.

H. K. L.—It would be obviously unfair to admit in these columns queries which are only of personal interest. These should properly be inserted in our advertising columns.

Jamie.—The book can be supplied on application to our publisher.

B.—The question was answered in our last number.

E. K.—We know of no sources of experiments on the aniline dyes than the lectures which have, from time to time, appeared on the subject in our pages.

Communications have been received from Dr. H. Lawson; E. Kernan; J. Emerson Reynolds; R. Weaver; H. Hudson; W. L. Spiers; F. M. Jenning; Messrs. Townsend and Adams; Hugh Munro; Jones, Bros., and Co.; R. Spice; G. H. Ogston; E. W. Streeter; L. Demuth and Co.; J. Simpson; S. and E. Collier; Morgan and Davies; J. Mosley (with enclosure); C. Tomlinson, F.R.S.; G. F. Rodwell; Street, Bros.; J. Browning; A. Norman Tate (with enclosure); J. Denman (with enclosure); J. Bagueley; A. B. Fleming and Co.; Dr. T. Wood; J. Coupland (with enclosure); S. E. Phillips (with enclosure); P. Squire (with enclosure); Longmans and Co.; W. A. Murray; H. Stephenson; R. Mallet, F.R.S.; H. Rey; Dr. Röhrig; Dr. Goedicke; E. C. C. Sanford (with enclosure); P. Finnegan; G. Preece; H. Crossley; F. Ritchie and Sons (with enclosure); J. Lee; P. M. Muir; W. Longworth; C. R. C. Tichborne, Professor Gunning (Amsterdam); F. Smith; W. H. Hancock; W. H. Perkin, F.R.S.; F. Field, F.R.S.; H. S. Ellis; J. C. Bowring; R. Kirwan; Dr. Lawson; T. Hill; M. Fletcher; E. Britten; Messrs. Townsend and Adams; J. Mercer; W. A. Todd; J. Davis; Griffiths, Bettison, and Co.; A. Jones (with enclosure); E. G. Tosh; W. Wyles; D. Brown; J. Kempster; W. Baxter; J. J. Griffin and Sons; J. A. R. Newlands; W. F. K. Stock; J. Bayne; W. Blench; C. G. Williams, F.R.S.; Moy Thomas; R. G. Bennett; F. Braby; S. D. Tillman; W. C. Roberts; J. Bethell; C. W. Heaton; Dr. R. Angus Smith, F.R.S.; E. Kernan; T. A. Orme; M. A. Baines; W. H. Perkin, F.R.S.; J. H. Cheshire; W. A. Murray; D. Brown; J. Kempster, C. S. Woodrowe; T. Huson; E. H. Moss; S. Mellor; W. Baxter; T. A. Pooley; F. Stevenson; J. Yates; W. Wyles; J. Millar; Green and Co.; Eicholtz and Co.; Todd and Son; Calvert and Co. (with enclosure); G. A. Keyworth; E. Meldrum; E. K. Muspratt; A. Warner; W. Huggon; B. Winstone; and White and Co.

Books Received.—"Laboratory Teaching; or, Progressive Exercises in Practical Chemistry." By Prof. C. L. Bloxam London: Churchill and Sons. "Pure Wine, and how to know it," by J. L. Denman. "Cyclopædic Science;" simplified by J. H. Pepper, F.C.S., Professor of Chemistry at the Royal Politechnic Institution; with 600 illustrations. London: Frederick Warne and Co. New York: Scribner, Welford, and Co. "The American Journal of Obstetrics and Diseases of Women and Children;" May, 1868, and May, 1869. Edited by E. Noeggerath, M.D., and B. F. Dawson, M.D. New York: W. A. Townsend and Adams. London: Sampson Low and Marston. Paris: J. B. Baillière.

AMERICAN SUPPLEMENT.

New York, July, 1869.

Croton Water—Its Quality.

We are led to make the following extracts from our report to the Metropolitan Board of Health, by the articles which appear so frequently of late in the daily papers, in which gross misstatements are made both with regard to the quantity as well as the quality of the Croton supply:—

"For the past two summers the water has been analysed twice a month, with the following results: One U. S. gallon of 231 cubic inches contained:

	Summer of 1867.	Summer of 1868.
	39 Analyses.	12 Analyses.
Inorganic Matter,	3.90 grains.	3.31 grains.
Organic and Volatile,	0.66 "	1.14 "
Total	4.56	4.45
Oxygen required to oxidize the organic matter: Permanganate of Potassa test,	0.1055 grains.	0.098 grains.

"A careful inspection was made of the sources of the Croton water supply, and 18 samples were collected at the more important points, representing all the larger brooks and streams." Analysis showed in one U. S. gallon:

	Most Impure.	Least Impure.	Average of the 18 Samples.
Inorganic matter,	5.73 grains.	1.20 grains.	3.72 grains.
Organic & volatile,	0.64 "	1.07 "	0.63 "
Total	6.37	2.27	4.35
Oxygen required to oxidize the organic matter,	0.0787 "	0.2519 "	0.1055 "

"The difference in purity shown by these waters was not unexpected, as some of the brooks rise high up among the hills, and pour down over pebbly beds to

TABLE SHOWING THE PURITY OF CROTON WATER AS COMPARED WITH THE WATERS OF OTHER CITIES.

RESULTS CALCULATED FOR 100,000 PARTS OF WATER.

Cities Supplied.	Source of Water.	Inorganic Matter.	Organic and Volatile Matter.	Total Solids.
New York	Croton: Average for three months, 1868 (C. F. Chandler)	5.66	1.97	7.63
New York	Croton: Average for thirteen weeks, 1867 (C. F. Chandler)	6.72	1.12	7.84
New York	Well west of Central Park (No. 1), (C. F. Chandler)	66.80	7.80	74.60
New York	Well west of Central Park (No. 2), (C. F. Chandler)	69 10	3.40	72.50
Brooklyn	Ridgewood: Average for three months, 1868 (C. F. Chandler)	3.91	1.43	5.34
Boston	Cochituate (E. N. Horsford)	4.12	1.22	5.34
Philadelphia	Fairmount, Schuylkill (E. N. Horsford)	3.95	2.06	6.01
Philadelphia	Delaware (H. Wurtz)	4.97	1.08	6.05
Albany	Hydrant (E. N. Horsford)	14.52	3.96	18.48
Troy	Hydrant (W. Elderhorst)	10.44	2.30	12.74
Utica	Hydrant (C. F. Chandler)	9.43	1.64	11.07
Syracuse	New Reservoir (C. F. Chandler)	20.81	3.08	23.89
Cleveland	Lake Erie (J. L. Cassels)	8.13	2.62	10.75
Chicago	Lake Michigan (J. V. Q. Blaney)	9.63	1.81	11.44
Rochester	Genesee River (C. F. Chandler)	20.62	2.12	22.74
Schenectady	State Street Well (C. F. Chandler)	80.38	4.00	84.38
Newark, Jersey City, Hoboken, Hudson City	Passaic River (E. N. Horsford)	7.85	4.90	12.75
Trenton	Delaware River (H. Wurtz)	5.02	0 95	5.97
London	Thames: Grand Junction Co. (Dr. H. Letheby)	26.67	1.43	28.10
London	Thames: West Middlesex Co. (Dr. H. Letheby)	22.60	1.21	23 81
London	Thames: Southwark and Vauxhall Co. (Dr. H. Letheby)	25.78	1.43	27.21
London	Thames: Lambeth Co. (Dr. H. Letheby)	25.36	1.78	27.14
London	Thames: Kent Co. (Dr. H. Letheby)	38.21	1.07	39.28
London	New River Co. (Dr. H. Letheby)	23.93	0.35	24.28
London	East London Co. (Dr. H. Letheby)	26.71	0.71	27.42
London	Well, Leadenhall street (Dr. H. Letheby)	154.98	16.44	171.42
Dublin	Lough Vartry, new supply (Apjohn and others)	3.04	2.30	5.34
Paris	Seine, above the city (Bussey, Wurtz and Ville)	13.43	1.70	15.13
Paris	Reservoir, Montmartre (Bussey, Wurtz and Ville)	17.73	3.50	21.23
Paris	Reservoir, Passey (Bussey, Wurtz and Ville)	19.81	3.21	23.01
Stockholm	Maelar Lake (Alex. Mueller)	47.00	7.00	54 00
Stockholm	Hagar Palace (Dr. Bahr)	27.88	3.26	31.14
Stockholm	Well, Hanwerkerstrasse (Alex. Mueller)	389.00	23.00	410.00
Amsterdam	River Vecht (V. Baumhauer & Van Moorsel)	24.78	3.66	28.44
Amsterdam	Deep well at the Keisersgracht (V. Baumhauer and Van Moorsel)	110.69	7.51	118.10
Amsterdam	Artesian Well at Bikkerseiland (V. Baumhauer and Van Moorsel)	106.89	2.31	109.20

the main stream, while others have their origin in swamps, and flow sluggishly along beneath the shadows of the swamp maple and the sumach."

"All are, however, remarkably pure."

"The foregoing table shows the comparative quality of the water used in several large cities in the United States and Europe. It will be seen that the Croton compares favorably with the best waters on the list. That the table might be more generally available for comparison, the results are given in parts of impurity in 100,000 of water.

"The results of these investigations, with regard to the quality of the water supply of New York, are eminently satisfactory, as the purity of the water is fully established. No one who has examined the district of 338 square miles which supplies the Croton River will be surprised at this result. Mountains and hills of azoic gneiss receive the rainfall, which is quickly absorbed and filtered by the pure silicious sands and gravels, to gush out in numberless springs, feeding the brooks which bear the sparkling waters to the ponds which serve as natural storage reservoirs. From these flow the large streams, which, by uniting, form the Croton River. This is finally expanded, by the dam at the head of the aqueduct, into a broad, deep lake, the *fountain reservoir*, in which the quiet waters deposit the finer sediments, and thus undergo a final purification before they are admitted to the aqueduct.

"Nowhere along the streams can anything be found which can render the waters impure. Rugged rocks or bright green pastures generally border them. A few factories have been located at points where the water-power was available, but a careful examination failed to reveal any pollution of the water by them.

"We were deeply impressed with the eminently satisfactory condition of everything connected with the Croton water supply. The condition of the lake and streams, the admirable site selected for the new reservoir, the care to prevent pollution of the waters, everything we saw satisfied us that the officers in charge fully appreciate the vital importance of guarding this great element of health, and of supplying it to the million of people residing on New York Island with its native purity undiminished."

The Croton water is now distributed from three reservoirs, all of which have been full during the entire season. Their capacity is as follows:

Fifth Avenue Reservoir	20 million gallons.
Central Park old Reservoir...	38 " "
Central Park new Reservoir..	1,000 " "

The department now furnishes to the city 65 million gallons of water per day, and the supply is more than equal to this enormous demand. If it were desirable 80 or 90 million gallons could be furnished.

To provide for dry seasons a dam is now in process of erection at Boyd's Corner, by which a fine natural basin will be changed to a great storage reservoir capable of holding 3,000 million gallons of water, which would carry the city through the driest season ever experienced.

Many other similar natural basins exist in the valley of the Croton and its tributaries, which by properly constructed dams can be made to retain the waters which fall during the winter months. There need be no fear for the future, therefore, as the 338 square miles of water-shed which supply the Croton are capable, with proper reservoirs, of furnishing to a city of many times the size of New York an abundant supply of water.

Both the quality and the quantity of the Croton water supply are therefore above reproach.

The Ballston Artesian Spring.

Twenty years ago the mineral waters of Ballston Spa rivalled those of Saratoga Springs, in the same county, and drew large numbers of visitors to the village every year. The springs were, however, finally lost. In making improvements about them the flow of water was in some way interrupted, and they found other outlets or were choked up entirely.

It is doubtful whether these waters would ever again have attracted attention had not an enterprising person bored an artesian well, in the vain hope of "striking oil." This patient but ill-advised seeker after petroleum selected a spot on the bank of the Kayáderosseras Creek, and bored down through sand, clay, and hard pan, fifty-six feet, till he struck the solid rock. He tubed the well down to the rock with an iron tube six inches in diameter, and then continued the boring with a five-inch drill. For a considerable distance the drill passed through the Hudson River shale, then it penetrated the Trenton limestone, then the Calciferous sand-rock, and, probably, passed some distance into the Potsdam sandstone. At a depth of 571 feet a vein of mineral water burst into the well; but as oil was the object of the search, it was not heeded. Finally, our zealous borer was spared any further labor in this direction by the steel reamer, which became so firmly fastened in rock, at the depth of 651 feet, that it could not be extracted.

No oil making its appearance, and further progress in the well being out of the question, attention was turned to the mineral water, when it was found that the most remarkable water of the county had been discovered.

The following analysis of the water was made by C. F. Chandler and E. W. Root:

Chloride of Sodium	750·030	grains.
Chloride of Potassium	33·276	"
Bromide of Sodium	3·643	"
Iodide of Sodium	0·124	"
Fluoride of Calcium	trace.	"
Bicarbonate of Lithia	7·750	"
Bicarbonate of Soda	11·928	"
Bicarbonate of Magnesia	180·602	"
Bicarbonate of Lime	238·156	"
Bicarbonate of Strontia	0·867	"
Bicarbonate of Baryta	3·881	"
Bicarbonate of Iron	1·581	"
Sulphate of Potassa	0·520	"
Phosphate of Soda	0·050	"
Biborate of Soda	trace.	"
Alumina	0 077	"
Silica	0·761	"
Organic matter	trace.	"
Total per gallon (231 cubic in.)	1233·246	"
Carbonic acid gas	426·114	cub.in
Density	1·0159	
Temperature	52°	F.

This is double the quantity of mineral matter contained in the Congress, High Rock, Star, or any other spring in Saratoga county. The discovery of a porous stratum of rock filled with this highly saturated solution of mineral matter confirms completely the opinion

long held by geologists with regard to the origin of the springs of this neighborhood.

Beginning with the uppermost, the rocks of Saratoga county are: 1. The Hudson River and Utica shales and slates. 2. The Trenton limestone. 3. The Calciferous sand-rock, which is a silicious limestone. 4. The Potsdam sandstone; and 5. The Laurentian formation, of unknown thickness. The northern half of the county is occupied by the elevated ranges of Laurentian rocks: flanking these occur the Potsdam, Calciferous, and Trenton beds, which appear in succession in parallel bands through the central part of the county. These are covered in the southern half of the county by the Utica and Hudson River slates and shales.

The Laurentian rocks, consisting of highly crystalline gneiss, granite, and syenite, are almost impervious, while the overlying Potsdam sandstone is very porous, and capable of holding large quantities of water. In this rock the mineral springs of Saratoga probably have their origin. The surface waters of the Laurentian hills, flowing down over the exposed edges of the Potsdam beds, penetrate the porous sandstones, become saturated with mineral matter, partly derived, perhaps, from the limestones above, and are forced to the surface at a lower level by hydrostatic pressure. The valley in which the springs all occur indicates the line of a fault or fracture in the rocky crust, the strata on the west side of which are hundreds of feet above the corresponding strata on the east.

The mineral waters, probably, underlie the southern half of the entire county, many hundred feet below the surface; the accident of the fault determining their appearance as springs in the valley of Saratoga Springs, where, by virtue of the greater elevation of their distant source or the pressure of the carbonic acid gas set free by chemical changes, they reach the surface through crevices in the rocks produced by the fracture.

As it flows from the spring the water is clear and sparkling, and is highly charged with gas. Down in the earth, where the water is under pressure, it is overcharged with gas, and the removal of this pressure, as the water comes to the surface, causes, as previously remarked, an escape of the excess. The flow of gas is somewhat intermittent; for, while the escape of bubbles is constant, there occurs every few minutes a burst of gas which causes the water in the tube to foam up to a considerable height.

The gases evolved are carbonic acid and light carburetted hydrogen or marsh gas.

The success of this well has induced others to make similar borings in search of water, and other wells are now in process of boring. Undoubtedly they will all, if carried to a sufficient depth into the Potsdam sandstone, reach the source from which the natural springs are supplied, and the concentration of the water will increase with the depth attained.

Wollongong Cannel Coal.

In the Wollongong District, N. S. Wales, and under the Kembla Mountains, is a series of bituminous beds containing cannel coals, somewhat resembling the Boghead coal of Torbane Hill, Scotland, but much less earthy. This coal is amazingly rich in oil and gas. It was tested at the experimental works of the Manhattan Gas Light Co., of New York, by Professors Silliman and Wurtz, and found to yield by the usual process of gas-making 6·12 cubic feet of gas per pound, having an illuminating power of 133 candles. Ordinary gas coals yield from 4½ to 5 cubic feet of gas per pound, of an illuminating power of from 12 to 18 candles.

These results greatly surpass those obtained from the Boghead and Albert coals, which have till now stood at the head of all gas-producing materials.

An analysis by the same chemists gave

Volatile Matter	82·50
Fixed Carbon	6·50
Ash	11·00
	100·00
The Specific Gravity is	1·049

Mr. Young, of Glasgow, one of the earliest pioneers in the manufacture of coal and shale oils, subjected a sample of the Wollongong coal to distillation, and obtained from one ton of 2,240 pounds 152 gallons of crude oil, sp. gr. 0·860, which he divided as follows:

Light Naphtha, sp. gr. 0·730	8 galls.
Burning Oil, " 0·815	72 "
Lubricating Oil, " 0·890	33 "
Paraffine. 49 pounds	5 "
Loss, ash, &c.	32 "
	150 "

With this cannel coal occurs another variety of cannel nearer the Boghead in character. A sample of this examined by the editor a year or two since, which was known then as "Australian shale," yielded

Gases	21·11
Water	3·33
Crude Oil	35·08
Fixed Carbon	26·48
Ash	14·00
	100·00
The Specific Gravity is	1·106

The crude oil had a specific gravity of 0·876, or 31° Beaumé, and measured 96·8 gallons per ton of 2,000 lbs.

Dangerous Kerosene.

We do not mean to allow a number of this journal to go to press without a paragraph calling the attention of our readers to this important subject. The apathy manifested by our law-makers is to us incomprehensible. Day after day we see accounts of horrible deaths from accidents: sometimes the lamp explodes, sometimes it is overturned; sometimes a fire is kindled with a little oil from the can; in numerous ways the fatality occurs; but the cause is always the same—*bad oil.* It has been our duty to examine the kerosene retailed in New York, and although we have purchased and examined upwards of 100 samples, we have not yet found a single sample of safe oil, oil which conforms to the regular legal standard—

"1. That it shall not take fire or burn at a temperature below 110 deg. Fah.

"2. That it shall not evolve an explosive vapor below 100 deg. Fah."

—while about twelve per cent. of the specimens are pure benzine, the most volatile and dangerous product of petroleum. State Prison for life should be the penalty for selling benzine for lamps, especially if it is sold under such names as "Safety Oil," "Liquid Gas," "Aurora Oil," &c., by which its real character is concealed.

These most dangerous oils can be recognized at once by applying a lighted match to a small quantity contained in a saucer. Every oil that can be lighted with a match should be condemned at once, as only *the most dangerous* will take fire at ordinary temperatures. The heart-rending, sickening sights we have seen at some of the hospitals in New York during the past winter—poor creatures, generally women and children, who were suffering the agonies of a lingering death from kerosene accidents—drive us almost wild whenever we think of them. We must have a crusade against the retailers of *dangerous kerosene.*

Carbolic Acid or Coal Tar Creosote.

Dr. Edward R. Squibb, of Brooklyn, read an interesting paper on this subject before the American Pharmaceutical Association at its last meeting, which appears in part in the *Am. Jour. of Pharm.* for May. Dr. Squibb separated from the crude carbolic acid the pure or nearly pure phenol or carbolic acid, and cresol or cresylic acid, and tested their comparative value as "azymotics," finding that the latter is more than twice as active as the former. This is a very important fact to establish, as it is usual, in selecting carbolic acid for disinfecting purposes, to suppose that the purer the acid, the better. In England much of the acid is almost chemically pure, appearing as a beautiful white solid. He advises, therefore, the use of the mixed acids, freed as much as possible from the inert hydrocarbons, under the name of coal tar creosote. His experiments are so well devised, and the information contained in the paper so important, that we refer the reader to the original article.

NEW PUBLICATIONS.

The Manufacturer and Builder,
A handsome quarto of 32 pages, is published monthly by Western & Co. of New York. It is printed on excellent paper, illustrated by numerous engravings, and is devoted to the mechanical and chemical arts. It is very ably edited, and although but six numbers have as yet appeared, its success is already assured. It is a journal which every enterprising mechanic should read. The editor, Mr. L. H. Mitchell, is specially qualified to conduct such a journal, having graduated at Harvard, studied Civil Engineering at Union, Assaying at Columbia, and Mining Engineering at Freiberg. The journal is also largely indebted to the able pens of Dr. P. H. Van der Weyde and Dr. Adolph Ott for valuable articles on chemical subjects.

The American Journal of Science and Arts, for May, 1869.
The articles in this number specially interesting to chemists are: 1. On the Atomic Volumes of the Elements. By F. W. Clark. 2. On some Minerals from Newlin Township, in Chester Co., Pa. By S. P. Sharples. 3. On the Washing of Precipitates. By Prof. R. Bunsen. 4. On the Origin of the Phosphatic Formation. By C. U. Sheppard, sr. 5. On some Derivatives of Trichlormethyl-sulpho-chloride. By O. Loew. 6. On the Occurrence and Composition of the Nodular Phosphates of South Carolina. By C. U. Sheppard, jr. 7. Process for determining the Carbon chemically combined with Iron. By Prof. Eggertz. 8. The Cohahuila Meteoric Irons of 1868. By J. Lawrence Smith. 9. Atomic Ratios. By Josiah P. Cooke, jr. 10. Notices of Papers in Physiological Chemistry. By Geo. F. Barker.

Final Report on the Geology of New Jersey. By Geo. H. Cook, State Geologist. Newark, 1868. 8vo, 900 pages, with engravings and maps.
This work contains a large amount of valuable information, much of it necessarily of a purely geological character. Considerable space is devoted, however, to the Iron Ores, Zinc Ores, Fertilizing Marls or Green Sands, Clays, &c. We agree fully with the reviewer of this report in Silliman's Jounal, who says "we are pleased to see a recognition of the well established fact that soil analyses are of but little benefit to farmers."

BREVITIES.

Prof. H. Dussauce, the chemist in charge of the laboratory of Tilden & Co., and editor of *The Industrial Chemist*, published in New York and Boston, died suddenly at his residence in New Lebanon, on the evening of June 21st.

Dr. R. A. Fisher, Professor of Chemistry at the University of California, sailed last week for Europe, to purchase apparatus, reagents, &c., for the equipment of his laboratories.

The incorporators of the National Institute of Letters, Arts and Sciences, met in New York, May 25th, and formally accepted the charter granted them by the Legislature of New York.

President Barnard, of the Columbia College School of Mines, as well as Prof. Egleston, Prof. Rood, and Dr. Schweitzer, will spend the summer in Europe.

Free Bathing Places for All.—We cordially give our support to the movement now on foot to secure free public baths. Nothing will more effectually improve the health, and even the morals, of the community.

The New York College of Pharmacy.—During the coming winter the lecturers will be W. D. F. Day, M.D., on "Materia Medica and Botany;" E. R. Squibb, M.D., on "Practical Pharmacy;" C.F. Chandler, Ph.D., on "Chemistry."

Oscar Loew, Chemical Assistant in the Chemical Department of the College of the City of New York, publishes an article in the May number of *Silliman's Journal* on "Some Derivatives of Trichlormethyl-sulphon-chlorid. ($C Cl_3$) SO_2Cl."

Dr. J. S. Newberry, Professor of Geology at the Columbia College School of Mines, has recently been appointed State Geologist for Ohio, and has already gone into the field for the summer, taking with him a corps of assistants and several students from the School of Mines.

A Curious Coincidence.—At about the time that Mr. H. C. Sorby exhibited, at the March soirée of the Royal Society of Great Britain, the indications of a new metal in zircons, O. Loew and H. Endermann, of New York, mentioned their entirely different reasons for suspecting the existence of a new metal in zircons, at a meeting of the Lyceum of Natural History.

Prof. S. W. Johnson's testimony in regard to the Earth Closet is worthy of candid consideration. Many a one who has read Victor Hugo's wonderful description of the sewers of Paris in "Les Miserables," has been deeply impressed with the vast amount of fertilizing wealth which is annually washed into the sea. What is true of Paris is true of every large city. The Earth Closet is of vast importance as regards the wealth of this country, and we are glad to see it receiving the attention of scientific men.—*The College Courant.*

The American Association.—The eighteenth meeting of the American Association for the Advancement of Science will be held at Salem, Mass., commencing on Wednesday, August 18th. On the afternoon of the first day of the meeting, the Association will be invited to participate in the dedication of the Museum of the Peabody Academy of Science, followed by a levee in the evening. For circulars containing full particulars of the meeting, address F. W. Putnam, Local Secretary, Salem, Mass.

Prof. Charles W. Eliot has accepted the position of President of Harvard College. He is decidedly the youngest president ever called to this institution. As he was Professor of Analytical Chemistry and Metallurgy at the Technological Institute of Boston, his election is a marked innovation on the old system of selecting college presidents from the clergy only.

Bunsen's New Filtering Apparatus, which was described and figured in the Chemical News (Am. Repr.) for June, p. 282, has been introduced into the laboratory of the Sheffield Scientific School at New Haven. Five of the water air pumps have been erected there at a very moderate expense. They work admirably, and enable the analyst to wash his alumina, sesquioxide of iron, and other gelatinous precipitates in a very short time. Some one remarked that this invention of Bunsen's would give at least 1000 years of additional effective time to the present generation of chemists. We think Prof. Johnson has improved a little on Bunsen's apparatus, at least in simplicity of construction.

The American Institute.—The American Institute will give an exposition of agricultural, mechanical, artistic, and other productions, in the city of New York, commencing on the 8th of September next. The large building known as the Empire Rink, on the corner of Sixty-third Street and Third Avenue, has been engaged for the exhibition, and will be open for the reception of goods on and after Sept. 1st. Articles should be directed to "The American Institute Exhibition, care of John W. Chambers, Secretary, corner of Third Avenue and Sixty-third Street, New York." The railroads, steamboats, and express companies have agreed to return, freight free, all articles exhibited, the freight on which to New York shall have been paid, provided they have not changed ownership, and are returned before Nov. 15th. The following are the departments of the exhibition: 1. Fine Arts and Education. 2. Department of the Dwelling. 3. Dress and Handicraft. 4. Chemistry and Mineralogy. 5. Engines and Machinery. 6. Intercommunication. 7. Agriculture and Horticulture.

Sad Accident to Prof. Bunsen at Heidelberg.—Prof. Bunsen recently met with a most serious accident, which threatens to deprive him of the use of his eye. He lost one eye many years ago in experimenting on kakodyl and its compounds, but has been able to accomplish an immense amount of work with the other. He is now in danger of becoming completely blind. A quantity of the rare metal rhodium, which had been precipitated by electricity, exploded spontaneously at his touch. His chief anxiety now is that he may regain his sight to enable him to find out why the rhodium exploded. The chemist who has given us the Bunsen's Battery, the Bunsen's Burner, the Bunsen's Photometer, the Spectroscope, Spectrum Analysis, Cæsium, and Rubidium, deserves our warmest sympathy.

AMERICAN DRUGGISTS' PRICE-CURRENT—NEW YORK.—JOBBERS' PRICES.

DRUGS AND CHEMICALS.

Aceton	per oz		to	35
Acid, Acetic, No. 8	per lb		to	18
Sp. gr. 1,047 U.S.P.	per lb		to	28
Chemically Pure	per lb		to	55
Glacial	per lb		to	1 60
Benzoic, German	per oz		to	30
Boracic, pure	per lb		to	85
Citric	per lb		to	1 20
Fluoric, 1 lb bottles	per lb		to	2 20
Formic	per lb		to	3 50
Gallic	per lb		to	3 25
Hydrophosphorous	per lb		to	4 25
Lactic	per lb		to	4 25
Muriatic, 18 degrees	per lb		to	5
chemical pure	per lb		to	38
Nitric, 38 degrees	per lb		to	15
chemical pure	per lb		to	38
Oxalic, patent	per lb		to	33
Phosphoric, glacial	per lb		to	3 00
Prussic	per oz	8	to	9
Sulphuric	per lb	4	to	5
chemical pure	per lb		to	50
Valerian	per oz		to	1 40
Tartaric, powdered	per lb		to	85
Aconite Leaves	per lb		to	28
Aconitia	per dr		to	5 00
Agaric Alba	per lb		to	80
Alcohol, 95 per ct	per gal		to	2 40
Aloes, Cape, powdered	per lb		to	36
Socotrine, powdered	per lb		to	1 15
Alum, Roman	per lb		to	11
lump	per lb		to	4½
Ambergris, gray	per oz		to	14 00
Ammonia Carbonate, bulk	per lb		to	24
in jars	per lb		to	25
Muriate	per lb		to	17
Ammonia Aqua, 20 degrees	per lb		to	12
26 degrees	per lb		to	22
Hypophosphite	per lb		to	4 25
Oxalate	per lb		to	2 25
Phosphate	per lb		to	2 00
Sulphate	per lb		to	10
Ammonium Valerian. Crystals	per oz		to	1 50
Ammonium Bromide	per lb		to	2 80
Hydrosulphuret	per lb		to	75
Iodide	per lb		to	8 50
Amygdalin	per oz		to	3 75
Antimony and Potass	per lb		to	1 10
Butter	per lb		to	30
Arnica Leaves	per lb		to	20
Arrow Root, Bermuda	per lb		to	45
St. Vincent	per lb		to	18
Arsenic, white powdered	per lb	8	to	10
red pulv	per lb		to	35
red. lump	per lb		to	20
Arsenic Solution, Fowler's	per lb		to	17
Iodide	per oz		to	90
Sol., Donovan's	per lb		to	33
Asbestos	per lb		to	15
Asparagin	per oz		to	3 50
Atropia	per dr		to	3 50
Sulphate	per dr		to	3 00
Valerian	per dr		to	4 50
Balsam Fir	per gal		to	4 75
Copaiva	per lb		to	1 10
Peruvian	per lb		to	6 00
Tolu, true	per lb		to	1 35
Barbadoes Tar	per lb		to	12½
Bark, Elm	per lb	18	to	20
Bark, Calisaya, quill	per lb		to	1 65
Red, quill	per lb		to	1 85
Pitavo	per lb		to	80
Cascarilla	per lb		to	30
Mezereon	per lb		to	28
Sassafras	per lb		to	12
Baryta Muriate	per lb		to	30
Nitrate	per lb		to	40
Bay Rum	per gal		to	3 75
Bebeerin, pure	per oz		to	5 50
Sulphate	per oz		to	3 50
Belladonna Leaves	per lb		to	25
Bicarbonate Soda	per lb		to	7
Bichromate Potash	per lb		to	23
Bismuth Metallic	per lb		to	8 50
and Ammonia Citrate soluble	per oz		to	85
and Ammonia Citrate Solution	per lb		to	1 30
Oxychloride	per lb		to	7 00
Subcarbon	per lb		to	8 00
Sub-Nitrate	per lb		to	7 50
Tannate	per oz		to	1 50
Valerianate	per oz		to	2 40
Black Drops	per lb		to	4 75
Blue Mass	per lb		to	58
Bole, Armenia, true	per lb		to	10
Borax, refined	per lb		to	40
Brimstone, roll	per lb		to	5
Bromine	per lb		to	3 50
Brucia	per oz		to	3 75
Buchu Leaves, long	per lb		to	62
short	per lb		to	33
Burgundy Pitch, true	per lb		to	15
Cadmium, Bromide	per oz		to	55
Iodide	per oz		to	70
Metallic	per lb		to	4 60
Sulphate	per lb		to	8 00
Caffeine	per oz		to	9 00
Calcium Chloride	per lb		to	90
Iodide	per lb		to	8 50
Calisaya Bark, Milhau's Original Elixir of	per doz		to	11 00
" " "	per gross		to	120 00
Calisaya Bark, Milhau's Chalybeate Elix. of	per doz		to	11 00
" " "	per gross		to	120 00
Calomel, Hydrosub	per lb		to	1 00
Camphor, Refined	per lb		to	1 05
Cannella Alba	per lb		to	30
Cantharides, powdered	per lb		to	2 20
Carbolic Acid crystals	per oz		to	17
" " solution	per lb	60	to	85
" " " common	per lb		to	25
Carbon Bi-Sulphuret	per lb		to	42
Cascarilla Bark	per lb		to	28
Cassia Buds	per lb		to	1 20
Castor Oil	per gal		to	3 00
Caustic Soda	per lb		to	9
Centaury Minor	per lb		to	38
Cerium, Oxalate	per oz		to	1 60
Nitrate	per oz		to	1 75
Chalk. Precip., English	per lb		to	23
Cherry Laurel Water	per lb		to	58
Chlorate Potass, English	per lb		to	50
Chloride Lime	per lb		to	8
Chloroform	per lb		to	1 38
Cinnamon, Ceylon, true	per lb		to	1 75
Citrine Ointment	per lb		to	58
Civet	per oz		to	5 50
Cobalt	per lb		to	26
Cocculus Indicus	per lb		to	36
Cocoa Butter	per lb		to	1 00
Codeine	per dr		to	2 50
Cod Liver Oil	per gal		to	2 25
Cod Liver Oil, (" Shore Oil ")	per gal		to	2 15
Cod Liver Oil, J. C. Baker & Co.'s	per doz		to	8 00
" " "	per gross		to	90 00
" " "	.5 gross, per gr		to	87 00
Cod Liver Oil, Hazard & Caswell's	per doz		to	7 50
" " "	per gr		to	90 00
Cod Liver Oil, Milhau's Golden	per doz		to	7 00
" Milhau's Etherized	per gross		to	78 00
Cod Liver Oil, Milhau's, with the Hypophosphite of Lime	per doz / per gross		to	7 50 / 84 00
Collodion	per lb		to	1 70
Cantharidal	per doz		to	4 50
Colocynth, powdered	per lb		to	75
Confectio Rosæ	per lb		to	48
Sennæ	per lb		to	48
Conium Leaves	per lb		to	25
Coniin	per oz		to	7 50
Copper Ammoniated	per lb		to	1 20
Black Oxide	per lb		to	2 20
Carbonate	per lb		to	2 20
Sulphur, pure	per lb		to	38
Copperas	per lb		to	4
Corrosive Sublimate	per lb		to	1 00
Cream Tartar, powdered, pure	per lb		to	50
Cubebs	per lb		to	33
Cubebin	per dr		to	25
Cuttlefish Bone	per lb	28	to	30
Digitalis Herb	per lb		to	18
Digitaline	per dr		to	3 65
Dover's Powder	per lb		to	3 00
Dragon's Blood, mass	per lb		to	1 00
reeds	per lb		to	1 10
Dulcamara Stems	per lb		to	18
Emetine	per oz		to	3 65
Emery Corn	per lb		to	11
Flour	per lb		to	8
Epsom Salts	per lb		to	4½
Ergot, new	per lb		to	1 30
Ergotine	per oz		to	1 15
Ether, Acetic	per lb		to	85
Butyric, concentrated	per lb		to	4 10
Butyraceous	per lb		to	1 60
Chloric	per lb		to	70
concentrated	per lb		to	85
Formic	per lb		to	4 00
Sulphuric	per lb		to	70
washed	per lb		to	80
concentrated	per lb		to	1 05
Extr. Jockey Club, Chirls	per lb		to	3 65
Extr. Ess. Bouquet, Chirls	per lb		to	3 75
Extr Banana, superior	per lb		to	1 25
Extr. Orange, superior	per lb		to	1 25
Fluor Spar	per lb		to	16
Flowers, Althea	per lb		to	42
Arnica	per lb		to	22
Borrage	per lb		to	95
Chamomile, German	per lb		to	30
Chamomile, Roman, 1867	per lb		to	36
Lavender	per lb		to	9
Malva, large	per lb		to	40
small	per lb		to	45

Flowers, Rosemary	per lb		to	70
Tiliae	per lb		to	70
Violet	per lb		to	68
Fusel Oil, purified	per lb		to	2 25
Ferro - Phosphorated Elixir of Calisaya	per doz		to	12 00
Bark, Hazard & Caswell's,	per grs		to	144 00
Gamboge	per lb		to	1 30
Gelatine French Pink	per lb		to	1 45
Gelatine, White French	per lb	85	to	1 00
Cox's	per doz		to	2 50
Ginger, Jamaica, bleached	per lb		to	30
Ginseng	per lb		to	85
Glauber Salts	per lb	3	to	4
Glycerine, common	per lb		to	35
concentrated	per lb		to	50
"Bowers"	per lb		to	80
"Price's"	per lb		to	1 15
Glycerole Hypophosphite	per lb		to	1 75
Grains D'Ambrette	per lb		to	60
Paradise	per lb		to	30
Gum Acroides	per lb		to	24
Amber	per lb		to	50
Ammoniac	per lb		to	60
Arabic, Turkey, sorts	per lb		to	55
1st picked, Trieste	per lb		to	95
2d " "	per lb		to	75
3d " "	per lb	55	to	60
Barbary	per lb		to	40
Assafœtida	per lb	65	to	70
Benzoin, common	per lb		to	90
prime	per lb		to	1 00
white marbled	per lb		to	1 10
Copal, Accra	per lb		to	
Benguela	per lb		to	30
Kowrie	per lb		to	45
Damar, Batavia	per lb		to	60
Singapore	per lb		to	55
Elemi, Aromatic	per lb		to	55
Euphorbium	per lb		to	25
Galbanum	per lb		to	1 60
strained	per lb		to	1 25
Gedda	per lb		to	30
Guaiacum	per lb	50	to	60
strained	per lb		to	60
Kino	per lb	65	to	70
Mastic	per lb		to	4 25
Myrrh, Turkey, powdered	per lb		to	75
Olibanum	per lb		to	30
tears	per lb		to	40
Sandarac	per lb		to	65
Shellac, Campbell's D. C	per lb		to	55
Garnet	per lb		to	52
No. 2	per lb		to	45
Native	per lb		to	48
Senegal	per lb		to	50
Tragacanth, common	per lb		to	50
flake	per lb	1 30	to	1 50
flaky sorts	per lb		to	60
Harlem Oil, Dutch	per doz		to	50
Hoffman's Anodyne	per lb		to	48
Hydriodate Potash, Atkinson's	per lb		to	5 35
Conrad's	per lb		to	5 20
Hyoscyami Leaves	per lb		to	26
Hypophosphite Ammon	per lb		to	3 75
Iron	per lb		to	8 50
Lime	per lb		to	3 75
Manganese	per lb		to	14 00
Potash	per lb		to	3 75
Soda	per lb		to	3 75
Iceland Moss	per lb		to	10
Indian Hemp, true	per lb		to	1 60
Insect Powder, true	per lb		to	1 10
Iodine, Resublimed	per lb		to	6 75
Crude, in bulk	per lb		to	6 50
Irish Moss	per lb		to	10
Iron, Alum	per lb		to	1 60
by Hydrogen	per lb		to	2 50
Carb. Proto	per lb		to	45
Precip	per lb		to	25
Citrate and Ammonia	per lb		to	1 45
Magnesia	per lb		to	1 35
Quiniæ	per lb		to	10 00
Strychnine	per lb	10 00	to	12 50
Hypophosphite	per lb	8 40	to	8 50
Iodide	per lb		to	8 25
Syrup	per lb		to	80
Lactate	per lb		to	3 25
Phosphate, Precipitate	per lb		to	67
Pyrophosphate	per lb		to	1 55
Syrup	per lb		to	65
Sesquichloride	per lb		to	1 45
Sol	per lb		to	60
Sesquinitrate	per lb		to	44
Subsulphate	per lb		to	1 70
Sulphate, pure	per lb		to	9
Exsiccat	per lb		to	17
Sulphuret	per lb		to	31½
Superphosphate Syrup	per lb		to	65
Tannate	per lb		to	6 60
India Ink	per lb		to	1 75
Isinglass, American	per lb		to	1 33
Russian, true	per lb		to	6 50
Juniper Berries	per lb		to	6
Juniper Tar Soap, Hazard & Caswell's	per doz		to	3 75
Kreosote, white	per lb		to	1 15
Lactucarium	per oz		to	75
Lead Acetate, pure	per lb		to	90
Licorice Paste, solid	per lb		to	40
Sicily	per lb		to	30
Calabria	per lb		to	44
Imitation	per lb		to	37
Barracco	per lb		to	43
P. S	per lb		to	44
Lime, Carbonate, Precipitate	per lb		to	22
Hypophosphite	per lb		to	3 75
Iodide	per lb		to	8 50
Phosphate, Precipitate	per lb		to	40
Sulphite	per lb		to	31
Lime Juice	per gal		to	80
Lint, Taylor's	per lb		to	1 80
Lapis Calaminaris	per lb		to	8
Laurel Berries	per lb		to	12
Leaves	per lb		to	12
Liquid Styrax	per lb		to	60
Long Pepper	per lb		to	90
Lunar Caustic, pure	per oz		to	1 30
67 per cent., N. S	per oz		to	90
Lycopodium	per lb		to	60
Magnesia Carbonate	per lb		to	45
Calcined	per lb	95	to	1 20
ponderous	per lb		to	1 80
Citrate	per lb		to	1 75
Sulphite	per lb		to	1 20
Manganese, powdered	per lb		to	8
Saxony	per lb		to	12
Manna, small flake, '68	per lb		to	1 75
large flake, '67	per lb		to	2 25
sorts, new	per lb		to	1 30
Matico Leaves, true	per lb		to	50
Mercury	per lb		to	90
cum Creta	per lb		to	56
Magnesia	per lb		to	1 22
Cyanuret	per lb		to	5 80
Sulphuret	per lb		to	80
Mercurial Ointment (⅓M)	per lb		to	70
(⅓M)	per lb		to	58
Morphia Sulphate	per oz	10 50	to	11 00
Acetate	per oz	10 50	to	11 00
Muriate	per oz	10 50	to	11 00
Valerianate	per oz		to	13 00
Musk, true	per oz		to	16 00
in grain true	per oz		to	32 00
Nux Vomica	per lb		to	14
Oil, Amber, Crude	per lb		to	60
Almonds (Expressed) Allen's	per lb		to	90
Essential, Allen's	per lb		to	24 00
Anise	per lb		to	4 25
Bergamot	per lb	6 00	to	7 00
FF, new crop	per lb		to	6 50
Bergamot, Donner's	per lb		to	7 00
Bergamot,—Sanderson's	per lb		to	7 25
Cade	per lb		to	1 00
Cajeput	per lb		to	2 00
Camphor	per lb		to	1 75
Caraway	per lb		to	2 75
Seed	per lb		to	5 50
Cassia	per lb		to	4 00
Cinnamon, true	per oz		to	1 25
Citronella, prime	per lb		to	2 50
Winter's	per lb		to	2 90
Copaiva	per lb		to	3 00
Croton	per lb		to	3 50
Cubebs	per lb		to	4 00
Cummin	per lb		to	10 00
Fennel	per lb		to	3 00
Geranium	per lb	12 00	to	22 00
Chiris	per lb		to	18 00
Prepared	per lb		to	25 00
Turkish	per lb	14 00	to	18 00
Jessamine	per lb		to	3 50
Juniper	per lb		to	1 20
Berries, true	per lb		to	3 50
Lavender, Garden, forte	per lb		to	1 65
fine	per lb		to	1 85
Flowers, Chiris, No. 1	per lb		to	3 75
Lavender Spike	per lb		to	1 00
Laurel, Expressed	per lb		to	90
Lemon, Donner's	per lb		to	4 25
Lemon,—G. R. & Co's	per lb		to	4 75
—Sanderson's (new)	per lb		to	4 75
Lemongrass,—Winter's	per lb		to	6 00
Mace, Expressed	per lb		to	2 50
Marjoram	per lb		to	1 75
Myrrbane	per lb		to	2 00
Neroli Bigarade	per oz		to	5 00
Chiris	per oz		to	4 75
Petit Grain	per lb		to	25 00
Olive, pure	per gal		to	1 75
Marseilles, quarts	per box		to	6 00
pints	per box		to	7 25
Orange	per lb		to	4 25
Origanum	per lb	75	to	1 40
Patchouly	per oz		to	4 25
Pennyroyal	per lb	3 75	to	4 00
Peppermint, pure	per lb		to	6 50
Rhodium	per lb		to	10 00
Rose, Kissanlick	per oz		to	10 00
Rosemary, French	per lb		to	1 75
Trieste	per lb		to	1 15
Chiris	per lb		to	2 25

Oil, Sabine, pure	per lb	to	1 70
Sassafras, cans	per lb	to	1 10
Sessame, Salad, fine	per gallon	to	2 60
Spearmint, Hotchkiss	per lb	to	6 00
Spike	per lb	to	
Succinum, crude	per lb	to	60
rectified	per lb	to	70
Tanzy,—"Eastman's"	per lb	to	5 00
Thyme, white, pure	per lb	to	2 75
Valerian	per lb	to	18 00
Wintergreen	per lb	to	4 85
Wintergreen, Van Deusen Bros	per lb	to	4 85
Wormwood	per lb	to	7 00
Wormseed, Western	per lb	to	2 75
Baltimore	per lb	to	3 50
Black Pepper	per lb	to	1 25
Cognac	per oz	to	3 50
Ergot	per oz	to	25
Opium	per lb	to	15 50
Orange Buds or Apples	per lb	to	18
Curacoa Ribs	per lb	to	28
Otto Rose, pure	per oz	to	10 00
commercial	per oz	to	7 00
Peppers, Zanzibar	per lb	to	33
Phosphorus	per lb	to	1 20
Amorphous	per lb	to	3 25
Piperin	per oz	to	1 50
Podophyllin	per oz	to	80
Poppy Heads	per lb	to	25
Potassa, Acetate	per lb	to	75
Bicarbonate	per lb	to	35
Carbonate	per lb	to	20
Caustic, common	per lb	to	65
white	per lb	to	95
Citrate	per lb	to	1 15
cum Calce	per lb	to	75
Hypophosphite	per lb	to	4 25
Permanganate, ordinary	per lb	to	80
Phosphate	per lb	to	2 75
Prussiate	per lb	to	44
Sulphate	per lb	to	16
Tartrate	per lb	to	1 05
Potassium	per oz	to	3 75
Bromide	per lb	to	1 65
Cyanide, fus	per lb	to	82
gran	per lb	to	1 50
Iodide	per lb	to	5 25
Sulphuret	per lb	to	35
Quinine, Citrate, with Iron	per oz	to	85
Sulphate, American	per oz	to	2 50
French	per oz	to	2 45
Quassia, rasped	per lb	to	7
Red Chalk Fingers	per lb	6½ to	7
Red Precipitate	per lb	to	1 15
Resin of Jalap, pure	per lb	to	28 00
Rochelle Salt	per lb	to	48
Roots, Aconite	per lb	to	24
Alkanet	per lb	17 to	18
Althea	per lb	to	22
Angelica	per lb	to	35
Calamus	per lb	20 to	60
Colchicum	per lb	to	20
Colombo	per lb	to	24
Culveris	per lb	to	20
Dandelion	per lb	to	30
Galangal	per lb	to	12
Gentian	per lb	to	20
Ginger, Race, African	per lb	to	20
Jamaica, Bleached	per lb	to	30
Golden Seal	per lb	to	30
Hellebore black	per lb	to	16
white, powdered	per lb	to	30
Ipecacuanhæ	per lb	to	3 15
powdered	per lb	to	3 25
Jalap	per lb	to	2 00
powdered	per lb	to	2 30
Licorice	per lb	to	18
Mandrake	per lb	to	15
Orris, Florentine	per lb	to	17
Verona	per lb	to	15
Pink	per lb	to	33
Rhatany	per lb	to	30
Rhubarb, E. I	per lb	2 50 to	4 00
Turkey	per lb	to	24 00
Sarsaparilla, Honduras	per lb	to	60
Mexican	per lb	to	28
Turbeth	per lb	to	60
Valerian, English	per lb	to	55
Dutch	per lb	to	40
German	per lb	to	26
Vermont	per lb	to	40
Snake, Virginia	per lb	to	44
Seneca	per lb	to	50
Rose Leaves	per lb	to	2 50
Rosemary Leaves	per lb	to	12
Rubigo Ferri	per lb	to	10
Saffron, American, new	per lb	to	2 25
Spanish, true	per lb	to	17 00
Sago, Pearl	per lb	to	12
Salicin	per oz	to	60
Sal Acetoscella	per lb	to	55
Ammoniac	per lb	to	16
Soda, Newcastle	per lb	to	5
Santonine	per oz	to	1 30
Sassafras Bark	per lb	to	10
Scammony, virg., true	per lb	to	20 00
Seeds, Anise	per lb	to	25
star	per lb	to	55
Canary, Dutch	per bush	to	5 00
Smyrna	per bush	to	5 00
Cardamom, Malabar	per lb	to	4 60
Carui	per lb	to	22
Celery	per lb	to	75
Clover	per lb	to	16
Colchicum	per lb	to	24
Coriander	per lb	to	16
Cummin	per lb	to	30
Fennel	per lb	to	20
Fœnugreek	per lb	to	12
Hemp	per bush	to	2 25
Linseed, American clean	per tierce	to	
rough	per bush	to	2 50
Bombay (gold)	per bush	to	2 50
Calcutta (gold)	per bush	to	2 55
Mustard, brown	per lb	to	16
white	per lb	to	16
Rape	per bush	to	5 25
Timothy	per bush	to	5 00
Worm	per lb	to	28
Seidlitz Mixture	per lb	to	45
Senna, Tinnevelly	per lb	to	28
Alexandria	per lb	to	50
E. I	per lb	to	25
Smalts, Blue	per lb	to	22
Snuff, Lorillard's Maccaboy	per lb	to	78
Coarse Rappee	per lb	to	1 00
Irish High Toast	per lb	to	85
Fresh Scotch	per lb	to	85
Soap, Castile, Mottled	per lb	to	16
White	per lb	to	25
floating	per lb	to	25
Low's Brown Windsor	per grs	to	15 00
Soda Acetate	per lb	to	80
Chlorate	per lb	to	2 15
Chloride, Liquor	per gal	to	45
Citrate	per lb	to	1 00
Hydrosulphate	per lb	to	1 05
Hypophosphite	per lb	to	4 10
Hyposulphite	per lb	to	10
Nitrate, pure	per lb	to	22
Phosphate	per lb	to	31
Pyrophosphate	per lb	to	1 25
Sulphite	per lb	to	32½
Ash	per lb	to	4
Sodium	per lb	to	11 00
Iodide	per lb	to	8 00
Spirit Ammonia	per lb	to	45
Aromatic	per lb	to	48
Lavender	per lb	to	48
Nitre Dulc	per lb	to	37
Rosemary	per lb	to	47
Sponges, Bahama	per lb	to	90
Bathing, Formes	per lb	to	4 00
Coarse Brown	per lb	to	60
Fine, medium	per lb	6 00 to	7 00
Surgeon's	per lb	4 00 to	7 00
Zimoca	per lb	2 00 to	8 00
Cup, Turkey	per lb	20 00 to	80 00
Trieste	per lb	4 50 to	18 00
Fine Toilet, bleached	per lb	12 00 to	15 00
Fine Trieste, small	per lb	4 00 to	4 50
Glove	per lb	1 75 to	2 00
Grass	per lb	to	25
Sheep's wool	per lb	1 60 to	1 70
Sur Choix	per lb	to	5 50
Squills	per lb	to	12
St. John's Bread	per lb	to	8
Strontia, Muriate	per lb	to	30
Nitrate	per lb	to	30
Oxalate	per lb	to	1 30
Strychnia, Acetate	per oz	to	3 75
Citrate	per oz	to	75
Nitrate	per oz	to	3 50
Pure, crystallized	per oz	to	3 25
powdered	per oz	to	2 75
Sulphate	per oz	to	4 00
Valerianate	per oz	to	5 50
Styrax Calamita	per lb	to	55
Sugar of Lead	per lb	to	40
Sugar of Milk	per lb	to	58
Sulphur Sublime	per lb	6½ to	7
Tamarinds	per lb	to	10
Tannin	per lb	to	2 75
Taploca, East India, white	per lb	to	12½
Pearl	per lb	to	15
Tartar Emetic, powdered	per lb	to	90
crystallized	per lb	to	1 10
Tin Foil, thin	per lb	to	45
French, No. 15	per lb	to	80
Tobacco	per lb	to	40
Tonqua Beans, Para	per lb	to	65
Augustora	per lb	to	85
Uva Ursi, American	per lb	to	12
French	per lb	to	18
Vanilla Beans, Bourbon	per lb1	11 00 to	12 00
Mexican	per lb	to	15 00
Venice Turpentine	per lb	to	33
Veratria	per oz	to	5 25
Vitriol, Blue	per lb	to	15
Green	per lb	2½ to	3

Vitriol, White	per lb	to	9
Wax, White,—J. I. Elkens	per lb	to	80
No. 2	per lb	to	77
Phillips'	per lb	to	90
Yellow	per lb	to	52
White Wax,—Leonhardt's	per lb	to	90
Ockmid	per lb	to	82
Sun-bleached	per lb	to	80
White Precipitate	per lb	to	1 50
White Pepper	per lo	to	58
Wine, Colchicum Seeds	per lb	to	1 40
Wood Naphtha	per lb	to	95
Wormwood Herb	per lb	to	25
Yellow Bark	per lb	to	30
Dock	per lb	to	25
Zaffre	per lb	to	1 15
Zinc, Acetate	per lb	to	1 25
Chloride	per lb	to	1 80

DYES AND DYESTUFFS.

Aniline Blue	per lb	to	8 50
Red	per lb	to	8 50
Violet	per lb	to	8 00
Annatto	per lb 1 00	to	1 75
Cochineal, Honduras	per lb	to	1 40
Mexican	per lb 1 30	to	1 40
Cudbear	per lb 28	to	45
Cutch, Pegue	per lb	to	15
Gambier	per lb	to	8
Indigo, Bengal, fine	per lb	to	3 25
good	per lb 2 50	to	2 75
middling	per lb 2 00	to	2 10
Madras, fine	per lb	to	1 70
ordinary	per lb	to	1 40
Kurpah	per lb	to	
Guatemala	per lb	to	2 00
Caraccas	per lb	to	1 65
Lac Dye, good to fine	per lb 55	to	60
Logwood, Campeachy	per lb	to	2¾
Honduras	per lb	to	2¾
Jamaica	per b	to	2¾
Laguna	per lb	to	2½
St. Domingo	per lb	to	2½
Extract	per lb 13	to	16½
" in bulk	per lb	to	13
Lima Wood (gold)	per bbl 70 00	to	71 00
Madder, Dutch	per lb	to	22
French	per lb	to	23
Nutgalls, Blue, Aleppo	per lb	to	40
Orchille	per lb 30	to	35
Persian Berries	per lb 50	to	55
Safflower	per lb 60	to	65
Sapanwood	per lb 12	to	15
Turmeric	per lb	to	15
Ultramarine	per lb 28	to	45
Woad	per lb 15	to	16

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials	50	percentage	discount.
German Flint Bottles and vials	30	"	"
Flint Bottles and vials	25	"	"
Furniture Ware	10	"	"
Perfumer's Ware	25	"	"
Chemical Ware	net	"	"
Syringes	10	"	"
Homœopathic vials	10	"	"

NAVAL STORES.

Pitch, City	per bbl	to	4 00
Rosin, Extra Pale	per 280 lbs 8 00	to	
Pale	" 7 00	to	
No. 1	" 5 00	to	
No. 2	" 4 00	to	
Strained	" 4 00	to	
Common	"	to	3 75
Spirits, Turpentine (North Carolina)	per gal	to	60
Turpentine, Soft	per 280 lbs	to	8 00

OILS.

Linseed Oil, American	per gal	to	1 10
English	per gal	to	1 10
Palm Oil	per lb	to	16
Paraffine Lubricating Oil	per gal	to	40
Sperm, Crude	per gal	to	2 10
Sperm, Winter, unbleached	per gal	to	2 20
Lard Oil Prime, City	per gal	to	1 75
Red Oil, City distilled	per gal	to	70
Red Oil, Saponified	per gal	to	78
Whale, Crude	per gal	to	1 15
Whale, Bleached, Winter	per gal	to	1 25

PAINTS (DRY).

Asphaltum, opt	per lb	to	7
Barytes, Foreign	per ton	to	45 00
Barytes, American	per lb	to	2
Black Lead	per lb 8	to	12
Black Ivory, drop, fair	per lb 10	to	18
good	per lb 18	to	20
best	per lb 24	to	28
Blue Celestial, good	per lb	to	14
Chinese	per lb	to	1 00
Prussian, fair to best	per lb 35	to	1 00
Ultramarine fair to best	per lb 23	to	45
Chalk, Lump	per lb	to	2¼
China Clay	per lb	to	2½
Chalk	per bbl	to	4 50
Green Paris, fair to best	per lb 35	to	50
Green Chrome, fair to best	per lb 33	to	42
Lamp Black—Coach Painter's—L. Martin & Co.'s.	per lb 23	to	25
Lamp Black, ordinary	per paper 8	to	12
Litharge, powdered, American & English	per lb 11	to	11½
Ochre, Yellow, French, dry	per lb 2½	to	4
Red Venetian	per lb 3½	to	5
Red Indian, fair to best	per lb 11	to	18
Red Lead, American	per lb 11	to	12
English	per lb	to	14
Rose Pink	per lb	to	20
Sienna, American	per lb 7	to	9
Italian, B'nt	per lb 18	to	22
Raw	per lb 15	to	20
Umber, Crude, Turkey	per lb 5	to	7
burnt	per lb 8	to	9
Tieman's Calif. Vermilion	per lb	to	1 00
Pure Carmine	per lb	to	14 00
Soluble Blue	per lb	to	1 25
Vermilion, English, pale	per lb	to	1 10
deep	per lb	to	1 10
American	per lb	to	35
Chinese	per lb	to	1 20
Trieste	per lb	to	1 20
White, China	per lb	to	22
Cremnitz	per lb	to	30
Lead, pure	per lb 13	to	14
good	per lb 9	to	11½
Paris	per lb 3½	to	4
Zinc, American	per lb 10	to	12½
Zinc, French	per lb 14	to	16
Whiting	per lb		3

PAINTS (IN OIL).

Black coach	per lb 28	to	30
Blue, Chinese	per lb 90	to	1 00
Prussian, fair to best	per lb 35	to	80
Brown, Van Dyke, fair to best	per lb 20	to	28
Dryer, Patent, American	per lb 12½	to	14
English	per lb 12½	to	15
Green, Chrome	per lb 18	to	27
Imperial	per lb 15	to	18
Paris	per lb 33	to	42
Verdigris	per lb 25	to	63
Putty, in bladders	per lb	to	5½
in bulk	per lb	to	5
Red Venetian, fair to best	per lb 8	to	16
Sienna, burnt, fair to best	per lb 22	to	35
White Lead, English, B. B	per lb	to	16
American, pure	per lb 13½	to	14
good	per lb 11	to	12½
fair	per lb 9	to	10
White Zinc, American	per lb 10	to	13
French	per lb 15	to	15½
Yellow Ochre	per lb 9	to	10
Chrome, fair to best	per lb 16	to	32

SPICES.

Cassia, in mats	per lb	to	70
Cloves	per lb	to	40
Ginger, Race, African	per lb	to	19
Mace	per lb	to	1 60
Nutmegs, No. 1	per lb	to	1 45
Pepper	per lb	to	38
Pimento, Jamaica,	per lb	to	34

WINDOW GLASS.

American Window—1st, 2d, 3d, and 4th qualities.

6	by	8	to	8	by	10	Per fifty feet	$ 6 25	to 3 75
8	by	11	to	10	by	15	"	6 75	to 4 75
11	by	14	to	12	by	18	"	7 50	to 5 50
13	by	16	to	16	by	24	"	8 50	to 6 00
18	by	22	to	18	by	30	"	10 00	to 7 00
20	by	30	to	24	by	30	"	12 50	to 8 00
24	by	31	to	24	by	36	"	14 00	to 9 00
25	by	36	to	26	by	40	"	16 00	to 10 00
28	by	40	to	30	by	48	"	18 00	to 14 00
24	by	54	to	32	by	56	"	20 50	to 16 00
32	by	58	to	34	by	60	"	24 00	to 18 00
34	by	62	to	40	by	60	"	26 00	to 21 00

The above is subject to a discount of 30 per cent.

French Window—1st, 2d, 3d, and 4th qualities. (Single thick.)

6	by	8	to	8	by	10	Per fifty feet	$ 6 25	to 4 75
18	by	11	to	10	by	15	"	6 75	to 5 00
11	by	14	to	12	by	18	"	7 50	to 5 50
13	by	18	to	16	by	24	"	8 50	to 6 00
28	by	22	to	18	by	30	"	20 00	to 7 00
20	by	30	to	24	by	30	"	12 00	to 8 00
24	by	31	to	24	by	36	"	14 00	to 9 00
25	by	36	to	30	by	48	"	16 00	to 10 00
28	by	40	to	30	by	48 (3 qlts)	"	18 00	to 14 00
34	by	54	to	32	by	56 (3 qlts)	"	20 50	to 16 00
32	by	56	to	36	by	60 (3 qlts)	"	24 00	to 18 00
34	by	52	to	40	by	60 (3 qlts)	"	26 00	to 21 00

Subject to a discount of 30 per cent. English sells at 10 per cent discount of the above rates.

THE CHEMICAL NEWS.
Vol. V. No. 2. American Reprint.

RESEARCHES ON TURACINE,

AN ANIMAL PIGMENT CONTAINING COPPER.*

BY A. H. CHURCH, M.A., OXON.,

PROFESSOR OF CHEMISTRY IN THE ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

From four species of *Touraco*, or plantain-eater, the author has extracted a remarkable red pigment. It occurs in about fifteen of the primary and secondary pinion feathers of the birds in question, and may be extracted by a dilute alkaline solution, and re-precipitated without change by an acid. It is distinguished from all other natural pigments yet isolated, by the presence of 5·9 per cent of copper, which cannot be removed without the destruction of the colouring matter itself. The author proposes the name *turacine* for this pigment. The spectrum of turacine shows two black absorption bands, similar to those of scarlet cruorine; turacine, however, differs from cruorine in many particulars. It exhibits great constancy of composition, even when derived from different genera and species of plantain-eater; as, for example, the *Musophaga violacea*, the *Corythaix albo-cristata*, and the *C. porphyreolopha*.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.†

BY DR. E. FLEISCHER, OF DRESDEN.

ON THE EMPLOYMENT OF CONSTANT FACTORS IN THE CALCULATION OF INDIRECT ANALYSES.

In the calculation of indirect analyses, it is of the highest importance that a factor should be found which, when multiplied by the weight of one of the substances to be estimated, gives the weight of the other. For the determination of this factor, the rule is to form two equations, expressing the relations of the atomic weights of the substances in question from different points of view. These constant factors may, however, be obtained more quickly and simply, without the assistance of equations, by the following method, which, besides facilitating calculation, is capable of employment by persons not sufficiently versed in mathematics to solve common equations.

Suppose two substances, X and Y, each of which is chemically combined with an acid or base: these two salts may be expressed by the common formula (X+C) + (Y+C); and consider the collective weight of these two compounds, which is found, by directly weighing, as equal to G. If we now assume that base or acid (to whichever the substances X and Y may be combined) is determined by analysis, and that this amount is represented by the weight C, X and Y will be the two substances to be found by calculation, and of which nothing further than their atomic weight is known.

Now, proceed as follows. First calculate what the weight of this salt would be if C were combined with the body X, having a smaller atomic weight than Y. Deduct this weight, which I will call g, from the collective weight of the two salts, which was G, and multiply the remainder by the constant factor S; the product will then be either $(G-g)\,S = Y$, or equal to the weight of the one substance, possessing the highest atomic weight which was to be indirectly found. The weight of X is obtained quite simply by deducting the sum Y+C from the collective weight G.

The determination of the constant factor ϕ is easily effected in the following manner. Suppose the two salts X + C and Y + C to be mixed together in the ratio of equal atomic weights, and add their atomic weights together. From this amount subtract the doubled atomic weight of the salt X+C (supposing X to be larger than Y), and divide the remainder by the atomic weight of Y; the quotient will then be the required constant factor for the case in point. Two examples in figures may, perhaps, render this mode of calculation more clear. The amount of K and Na contained in a weighed mixture of chloride of potassium and chloride of sodium is to be determined, the collective amount of chlorine having been ascertained in the volumetric mode, by means of a solution of standard silver; the required factor ϕ is then found as follows:—

	1 equiv.	K Cl = 74·6
	+1 "	Na Cl = 58·5
Hence—1 equiv. KCl + 1 equiv.		Na Cl = 133·1
When deducting—	2 "	Na Cl = 117·0
A remainder is left of—		16·1

This remainder of 16·1, divided into the atomic weight of K=39·1, gives, as a constant factor,—

$$\phi = \frac{39{\cdot}1}{16{\cdot}1} = 2{\cdot}4285.$$

Let us suppose that the united weights of chloride of potassium and chloride of sodium amount together, in a given case, to 1·916 grms., while the total amount of chlorine found weighs, when calculated as chloride of sodium, 1·755, grms. The differencebetween these two weights will then be—

1·916 grms.
−1·755 "
0·161

This remainder of 0·161 grms. gives, when multiplied by the constant factor 2·4285, the amount of potassium 0·390988 grms., or, in round numbers, 0·391 grms. of potassium. This weight, and the ascertained total of chlorine, *viz.*, 1·065 grms., deducted from the weight of both salts=1·916 grms., gives 1·916−1·065−0·391= 0·460 grms. of sodium.*

Let us take as our second example the estimation of chlorine, bromine, and iodine, in combination, by a solution of nitrate of silver. Several simple methods of effecting this are known. Among them is one I would especially recommend, in which the iodine is separately estimated, by distillation with sesquichloride of iron, or by precipitation as subiodide of copper; while the amount of silver required for precipitating the three silver compounds is determined by subsequently ascertaining the silver contained in the filtrate, and deducting it from the measured testing solution employed. This method is preferable, because one weighing of the chloride, bromide, and iodide, of silver, with the addition of the iodine already found, and the ascertained quantity of silver, suffices to calculate the weight of the three halogens where several weighings would be required.

I have intentionally chosen the most complicated

* Abstract of a paper read before the Royal Society, May 27th, 1869.
† Communicated by the Author.

* The potassium and sodium contained in the mixed salts are therefore found by calculation.

[English Edition, Vol. XIX., No. 496, page 265.]

method of calculation, in which the directions are as follows:—Weigh the amount of precipitated chloride, iodide, and bromide of silver, then transform all the chloride into bromide of silver by a lengthy digestion with bromide of potassium (which must be quite free from iodine), weigh the precipitate, which will now consist of only bromide and iodide of silver, and digest the weighed precipitate with iodide of potassium, whereby all the bromide of silver is changed into iodide, and the precipitate, which is to be again weighed, will contain merely silver and iodine.

It will be perceived that the last weighing of the iodide of silver only serves to ascertain the total amount of silver which is contained in all the precipitates: if this be known, the transformation of the bromiodide of silver into iodide of silver by iodide of potassium can, of course, be omitted, and also the third weighing. Thus we have here determined the amount of silver which was combined with the three halogens, chlorine, bromine, and iodine. The same amount of silver was also contained in the precipitate of bromiodide of silver. We will now calculate the constant factor for these two combinations in the following way:—

	1 equiv. AgBr=	188
+	1 " AgI = ...	235
	1 equiv. AgBr+1 equiv. AgI=	423
Thence deducting—	2 " AgBr=	376
Gives as remainder—		47

If we divide 127, the atomic weight of iodine, by the remainder, 47, the constant factor between bromide and iodide of silver will be—

$$\phi = \frac{127}{47} = 2{\cdot}7021$$

The factor between chloride and bromide of silver, which is also required, is calculated in a similar manner—

AgCl = ...	143·5
AgBr = ...	188 0
AgCl+AgBr = ...	331·5
Hence— 2 AgCl=	287·0

And 80 Br, divided by the remainder, 44·5, gives—

$$\phi \; 1 = \frac{80 \cdot 0}{44 \cdot 5} = 1{\cdot}7977$$

as the factor between AgCl and AgBr.

Let us now suppose the weight of the third deposit to amount to 1·645 grms.; its proportion of silver (similar to that in the other deposits) will therefore amount to 0·756 grms.; and, supposing the weight of the iodide and bromide of silver (the second precipitate) to be 1·363 grms., the amount of iodine may be calculated as follows:—

The weight of AgI+AgBr was—	1·363 grms.
Thence deducting the amount of AgBr which corresponds to the weight of silver of 0·736 grms., namely—	=1·316
The remainder of—	0·047

multiplied by the factor ϕ for iodide and bromide of silver, 2·7021, gives—

0·047 × 2·7021 = 0·1269987 grms. of iodine.

Let us assume that the weight of the first precipitate of chloride, bromide, and iodide of silver amounts to 1·185 grms.; there will then remain, after deducting the amount of Ag corresponding to the iodine found,

	1·185 grms.
—0·235 "	
a remainder of—	0·950

which represents the collective weight of the chloride and bromide of silver.

Since, then, the collective weight of silver amounts to 1·756 grms., and that contained in the form of iodide of silver to 0·108 grms. (corresponding to 0·127 grms. of iodine), the weight of silver which was contained in the first deposit as AgCl and AgBr is 0·756—0·108=0·648 grm. This amount of silver, when considered as chloride of silver, gives 0 861 grm. AgCl; and this, subtracted from the weight of chloride and bromide of silver, gives—

0·950 grm.	AgClAgBr
0·861 "	AgCl
a remainder of—	0·089

which, when multiplied by the factor between chloride and bromide of silver, ϕ=1·7977, gives—

0·089+1·8=0·160 grm. Br.

Lastly, if the collective weight of silver, together with that of the iodine and bromine, be deducted from the weight of the first precipitate of chloride, bromide, and iodide of silver, the weight of the chlorine will be 1·185—0·756—0·127—0·160=0·142 grms. The substance in question contains, therefore, about 1 equiv. of iodine, 2 of bromine, and 4 of chlorine.

Indirect analyses are always very good for rapid estimations without separation, but they are specially recommended when the known methods of separation are very minute, and therefore give rise to faults; or if the amount of one body be much larger than that of the other, which renders separation more difficult.

In the succeeding description of the estimation of baryta, strontia, and lime, the convenience of indirect analysis will be specially demonstrated; and it is hoped that the mode by calculation, above explained, and which is as simple as it is quick, will no longer be disregarded.

ON THE

METHODS OF DETERMINING

THE AMOUNT OF

PRECIPITATED OR REDUCED PHOSPHATES IN ARTIFICIAL MANURES.

BY JOHN HUGHES, F.C.S.

My attention has been directed to a communication from Mr. J. A. Chesshire (analytical chemist at the manure works of Messrs. Bradburn & Co., Wednesfield), published in a recent number of the Chemical News, in which a new method of estimating the amount of precipitated phosphates present in superphosphate and similar artificial manures is recommended, namely, that of boiling the portion insoluble in water for about half-an-hour with a solution of oxalate of ammonia, adding a few drops of oxalic acid.

I am surprised that any such process should have been recommended by a chemist, as it is an acknowledged fact that oxalate of ammonia, even in a cold solution, possesses the property of acting on insoluble phosphate of lime to an appreciable extent. Liebig has referred to this function of oxalate of ammonia when speaking of Peruvian guano, and has pointed out that

this salt, which is present in guano in a variable proportion, plays an important part in rendering the insoluble phosphates to a certain extent soluble.

More recently, Dr. Voelcker, in a paper "On the Means of Increasing the Efficacy of Peruvian Guano" (published in the *Journal of the Agricultural Society*, 1864), has described some interesting experiments which prove that oxalate of ammonia, which is always present, even in best Peruvian guano, has the effect of rendering the insoluble guano phosphates soluble. He found, moreover, that this effect is greater when comparatively little water is mixed with guano, and the concentrated solution of oxalate of ammonia thus produced is allowed to react for several hours upon the insoluble guano phosphates, than when much water is added, and the weak oxalate of ammonia solution is filtered off at once from the insoluble portion of the guano.

It might be urged that the peculiar solubility of a certain proportion of the phosphates in guano is probably due to the minute state of division in which they are present in this material; I have, therefore, made the following experiments with ground Cambridge coprolite, a phosphatic mineral, which is particularly hard, and which, I need hardly mention, contains no so-called "reduced" or precipitated phosphates.

Twenty grains of coprolite were boiled for about half-an-hour with 4 ounces of a solution which contained 10 grains oxalate of ammonia and 20 drops of oxalic acid solution (strength, 1 in 30); the insoluble portion was then removed, and the phosphoric acid in the filtrate determined as pyrophosphate of magnesia, the results being calculated as tribasic phosphate of lime. A second experiment was made, in which 20 grains of oxalate of ammonia were added, instead of 10 grains.

The solution (filtrate), in the

1st experiment, contained phosphoric acid	3·48	per cent
(Equal to tribasic phosphate of lime	7·61)	"
2nd experiment, contained phosphoric acid	4·60	per cent
(Equal to tribasic phosphate of lime	10·05)	"

As it might appear that free oxalic acid was the principal agent in rendering the coprolite phosphates soluble, I made another experiment, in which oxalate of ammonia alone was employed.

Twenty grains of coprolite powder, 40 grains oxalate of ammonia, and 4 ounces of water were digested for half an hour, and the solution subsequently treated in precisely the same way as before.

In this experiment, I found in the filtrate—

Phosphoric acid.....	5·38	per cent
(Equal to tribasic phosphate of lime	11·75)	"

It will be seen that oxalate of ammonia acts with considerable energy upon hard mineral phosphates; it is natural, therefore, to suppose that it will render soluble the insoluble phosphates frequently present in artificial manures, in the shape of bone or bone-ash, to a greater extent than it will hard mineral phosphates.

Your correspondent assumes that the plan of boiling out the insoluble portion of a manure with citric acid, is the one now generally employed in estimating the amount of precipitated phosphates, but I do not know any laboratory in which this practice prevails; at all events, the citric acid plan has been found impracticable in Dr. Voelcker's laboratory, where I am engaged at present.

Recently-precipitated phosphates, unquestionably, are more valuable than raw mineral phosphates; still it cannot be maintained that they are as efficacious and valuable as phosphates actually soluble in water.

As long as we cannot separate with accuracy precipitated from ordinary insoluble phosphates, it is certainly objectionable to introduce into analytical statements the term "precipitated" or "reduced" phosphates.

There is no difficulty in broadly distinguishing between phosphates actually soluble in water and phosphates insoluble in water; and it appears to me desirable to adhere to the present plan of guaranteeing the quality of mineral superphosphates—by stating the percentage of soluble and insoluble phosphates which they contain.

A CHEMIST'S VIEW OF THE SEWAGE QUESTION.*

BY EDWARD C. C. STANFORD, F.C.S.

(Concluded from Am. Repr., July, 1869, page 18.)

Earth Carriage.

This subject has been already brought before you; but as its chemical aspect has not been treated, I shall briefly allude to it. Some misconception appears to have prevailed here as to the disinfecting power of dry earth and ashes; both are absorbents of moisture, and to this extent, and no further, are these disinfectants. This may be easily proved by filtering putrid urine through either of these media; it passes unchanged.

These materials are only, therefore, deodorisers when largely in excess of the fæcal matter to which they are added.

Thus to take dry clay, the best substance of the kind, it would require three and a half times as much as the excreta, or 17,500,000 cubic feet to be brought into the city, and 22,500,000 cubic feet to be taken out again; and the actual value of this product would be £208,333, or 2¼d. per cubic foot, or 6s. 7d. per ton. Its practical value would, however, be much less, because, on account of the expensive carriage, the value of a manure decreases in inverse geometrical proportion to its strength. It stands to reason, therefore, that if a dry vehicle is to be resorted to, it must be more economical to use some substance which increases, rather than diminishes, the agricultural value of the product, especially if less of it can be employed to do the same work. That substance which, while acting as a deodoriser, also absorbed the most water for a given weight, and added its value to the product, should, theoretically, be the best for this purpose. I find that, while perfectly dry clay only absorbs 45 per cent of water, dry seaweed char absorbs 147 per cent, and the former becomes a sludgy mud, while the latter can be easily removed.

The use of an absorbent of this kind would, therefore, reduce the amount of material to be brought into the city to less than one-third, or to an amount equal to the excreta to be removed; or 5,000,000 cubic feet brought in, and 10,000,000 cubic feet taken out, annually, the daily removal being 385 tons in, and 770 tons out. This is not more than the present daily removal of ashes, while there would be no greater nuisance, and the value, exclusive of the value of the charcoal, would be about 15s. per ton. Viewed in this light, the dry closet system presents strong claims to notice, and, in a sanitary sense, its arrangements are perfect.

* Read before the Glasgow Sewage Association, March 30th, 1869.

Air Carriage.

Carriage by atmospheric pressure possesses several advantages afforded by neither of the former systems, both of which add a large bulk of valueless but costly material to the excreta to be removed. Considering the great value, and easy application, of pneumatic pressure, it is remarkable that so little attention has been directed to it as a means of dealing with excreta; it has been entirely overlooked by those great authorities who have professed to look into all the bearings of this difficult question.

The principal effort in this direction is due to Captain Tiernur. I will briefly describe the main features of this proposition, referring to "The Sewage Question," by Krepp, for further details. Captain Tiernur proposes to place in houses a simple open-pan closet of a particular form, in connection with a vertical soil-pipe, and so shaped that the total excreta fall at once to the bottom of this pipe in the basement storey of the house, where it collects in a small syphon bend. The soil-pipe is made of earthen-ware, 14 to 16 inches in diameter, and is continued to the top of the house, where it is open to the air, and covered with a wind-guard for ventilation. The syphon bend and bottom of the pipe are of cast-iron narrowed from the soil-pipe to a 5-inch cast-iron pipe. This is continued to a central receiver, sunk in the public street. This reservoir has about 20 cubic feet capacity; and allowing 1 cubic foot to every thirty-six individuals, each serves about 700 persons and a number of houses. Each house has a so-called house-valve, which is accessible from the street, and closes the connection with the sewage reservoir. This reservoir may be placed in any central position in the public street, sunk under the ground, and surmounted by an ornamental lamp-post, within which the two communicating pipes are concealed. It is of a nearly spherical shape, or quite spherical top and bottom, with cylindrical sides. It receives the drain-pipes from a number of houses, collected in four main branches, which enter it with a slight bend at the top; the house pipes and main pipes are all about 5 inch bore, the former entering the latter horizontally at an angle of 30°, and a curve of 2 feet radius. The main pipes have a gentle downward inclination towards the reservoir, but enter it by a sudden bend upwards. There are two vertical pipes concealed within the lamp-post—one, the air-pipe, about 3 inch bore, fixed to the top of the reservoir; and the other the exit soil pipe, about 6 inch bore, continued nearly to the bottom of the reservoir.

The mode of filling and emptying these receivers is by a "locomotive engine and pneumatic tender," which is drawn by one horse, assisted by the steam power of the engine, to the several reservoirs during the night. The process is simple; the engine works a powerful air-pump, which is placed in connection with the reservoir and the tender; in about three minutes the gauge indicates a vacuum of about 10 lbs. to the square inch, or about 20 in. barometer pressure, and both are sufficiently exhausted. The several house-valves are then opened and closed consecutively, and the contents of the syphons instantly shot into the receiver by the downward pressure of air in the soil-pipe, the vertical ventilating shaft acting like a pea-shooter. When all the house-traps are discharged, the air-pipe of the receiver is disconnected, the exit soil-pipe connected with the exhausted tender, the contents thus transferred to it, and the whole machine is driven off to the next reservoir; the foul gas from the air-pump is blown into the engine furnace. The tenders have each 100 cubic feet capacity, 10 cubic feet of which is used as a water-tank to the engine. When full, these are taken to "decanting houses," where the contents are transferred to barrels. These barrels are 28 inches in diameter, 32 inches long, about 5 cubic feet capacity, and made of strong oak staves bound with iron hoops; they form the stores for the manure, and for its transport, and are to be sold direct to farmers. For applying the contents directly to the soil, which is Captain Tiernur's special object, he proposes plans of ingenious manure ploughs and meadow manurers, which support the barrel and empty its contents at once into the furrow, where it is covered over and kept at once from decomposition. During frost, he proposes keeping these barrels in store.

The method of collecting, and particularly of applying, the excreta in these barrels, seems to me a most unnecessary complication. Glasgow would collect at the rate of 2,740 barrels a day, and a month's frost would accumulate an explosive store of 82,000 barrels; while in the summer I fear the barrels could not be used fast enough to prevent decomposition. There is also this great objection to this method, which applies, also, to irrigation, that we are compelled to sell our manure constantly to get it off our hands, and by making the farmer take it when he does not want it, and cannot advantageously apply it, we are entirely at his mercy, and must accept his prices; but if we could store, make it into good manure, and sell it when he wants it, then, and not till then, can we expect to realise its value. If the other parts of this plan work well, a modification would make this feasible.

We have a material to deal with in chemical works which presents some analogy with that under consideration; it must be kept from the air, it cannot be handled; but it is nearly double the weight of the excreta, and very corrosive. Yet this is lifted, without any difficulty, to great heights, and carried long distances, with no trouble and little expense, by atmospheric pressure; and could not the excreta be dealt with in the same way? The drain-pipes from the houses should be led into iron reservoirs, the size and number of these to be determined; the total daily removal being only 13,700 cubic feet, twelve cylindrical boilers with egg-shaped ends, about 10′ × 10′, by 15 to 20 feet long, sunk vertically, would be sufficient for Glasgow. It might, however, be advisable to have smaller vessels in larger number; that is a matter of detail.

These reservoirs are all to be connected, by a small air-pipe, to one or more central pumping stations, where a powerful air-pump is fixed; each, also, to be furnished with an exit soil pipe, passing to the bottom, and continued up into a main pipe leading to one or two manure works situated some miles out of town.

This would, then, be the process of removal; at a fixed hour at night the air-pump would be set to exhaust a large iron reservoir at the pumping station, and communicating with the air pipes attached to the soil reservoirs. Two men for each district would then be sent round, and, opening the air-pipe valve, would place each receiver in connection with the exhausting pump, and then open, consecutively, the house-valves, by which means the soil-pipes would be nightly discharged, and the whole closet ventilated by a powerful blast of air. This is one operation. During the day, at a certain hour, the engine and air-pump would be reversed, and pump air into the air-vessel at the pumping station; the several soil reservoirs would then be placed in connec-

tion, and the contents lifted, by the atmospheric pressure, away to the manure works.

When we consider that a pressure of 50 lbs. on the square inch can be thus easily applied, there is merely the friction and some little weight to overcome; the plan seems quite practicable, and is, at any rate, worth a trial. The piping required would be an arterial system of small cast-iron piping; its cost, compared to sewers, would be little, and the cost for pumping must be insignificant, compared to that for lifting sewage in such enormous quantities.

The Abbey Mills pumping station has eight engines, 142 horse power each, or 11·36 horse power; and these lift 15,000 cubic feet a minute 36 feet high. We have only to lift 385 tons, or 13,700 cubic feet, and the whole day's produce of Glasgow may be contained in a tank 30 feet square and 16 feet deep. These pumps, therefore, would do our day's work in fifty-four seconds.

When engineers talk of intercepting sewers for our sewage, they mean immense culverts of brick, which leak in all directions, and are full of noxious gases, to carry off 137,000 tons of sewage a day, containing 385 tons, or 1-355th of excreta, and only 38½ tons, or 1-3550th of its weight, of solid excreta. My notion of a true intercepting sewer is a perfectly tight and cheap cast iron pipe, which will really intercept this excreta, and deal with it alone. It is, to all intents and purposes, a fluid, and subject to all the laws of fluid pressure; to add 355 times its weight of water to *make it fluid*, is not only "carting coals to Newcastle," but it is paying very heavily for the pleasure of doing so.

Engineers should consider the possibility of removing, without nuisance, the excreta, as it is, from where it is to where it should be; because, if it can be so delivered, the further disposal of it can be safely left to chemists, who may, then, be fairly asked to turn it to account. We have not hitherto had a fair chance; engineers are allowed to mix the excreta with much water, and then to turn round and ask chemists to separate it again, forgetting that the "*reductio ad absurdum*" is *not* a chemical process.

Dickens, in his preface to the last edition of "Pickwick Papers," after referring to the great improvements which have taken place since he wrote the work, ventures a hope that "it may some day be discovered that the universal diffusion of common decency and health is as much the right of the poorest of the poor as it is indispensable to the safety of the rich and of the state; that a few petty boards and bodies—less than drops in the great ocean of humanity which roars around them—are not forever to let loose fever and consumption on God's creatures at their will, or always to keep their jobbing little fiddles going for a dance of death."

No. II.*

About twelve months ago, I read a paper on this subject before the Sewage Association of Glasgow; since then, the members of that association, with all their varieties of opinion, have passed one unanimous resolution—that, whatever system may be adopted, the excreta must be kept out of the public sewers, the expression of a conviction which will be that of any patient inquirer into this difficult question.

In the paper referred to, I endeavoured to show that, whatever may be the best, the present water-closet system, with all its boasted advantages, is the worst that can be generally adopted; briefly, because it is a most extravagant method of converting a mole-hill into a mountain. It merely removes the bulk of our excreta from our cities, to choke our rivers with foul deposit, and rot at our neighbours' doors. It increases the death-rate, as well as all other rates, and introduces into our houses a most deadly enemy, in the shape of the sewer gases.

Since then, the report of Messrs. Bateman and Bazalgette has appeared, and it proposes (what every one knowing the views of the authors would at once have predicted) to put down miles of costly sewers to carry the excreta to the Ayrshire coast, where, perhaps, the inhabitants may oblige us to take it back again; in other words, to commit the error of London, and wake up in a few years to the same bitter repentance.

We cannot be surprised at this; we cannot expect homœopathic treatment from an allopathic physician, especially if, as in this case, "bleeding" is to be again the universal cure. The engineer's treatment of town excreta always reminds me of the country doctor in America, who put all his feverish patients through a course of convulsions, because, though he didn't understand *fevers*, he *could* cure *fits*. In our numerous discussions, I have always maintained that chemists have been most unfairly treated in this matter. The public like to see what they pay for; they can see bricks and mortar and therefore have allowed engineers to give them an intimate pocket-purse knowledge of this expensive commodity, for which they have paid in more than one sense—through the nose. Engineers have too fondly believed that water is the great purifier, and so they dilute the excreta with 365 times its bulk of water, and reduce its value to 1d. per ton, and then turn round on the chemist and expect him to reverse the process, pick out the penny, and repay the expenditure. Now, if it were a simple mixture—if it were only to separate the grain of wheat from the sack of chaff—the problem would be difficult enough; but we know the case to be far worse than this—it is the handful of yeast in the sack of flour that we are called upon to extract, and the fermentation of which we are expected to prevent, *after* it has occurred. A small portion of dilute sewage, mixed with a large excess of water, soon renders it all equally offensive, and the problem of extracting its value is one which no chemist need ever attempt to solve.

The water-closet, with many apparent advantages, and with all our prejudices in its favour, carries an attendant train of evils, which I am fully persuaded will ultimately doom it to oblivion.

As, therefore, engineers have not put the subject fairly before chemists, I propose to take a noble revenge, and put the subject fairly before engineers. I ask them why they consider water to be the only vehicle for removing excreta?—why not earth?—why not air? Have they ever fairly investigated or thoroughly experimented on the other methods? Have they not rather confined their studies to *fits*, and forgotten *fevers?*

So many attempts have been made by chemists to pick up the halfpence that engineers have so plentifully flung into the mud, that I cannot even notice them, except to remark that, in the opinion of all the scientific chemists who have specially investigated these attempts, they have all signally failed.

I must allude, however, to the process of Mr. Chapman, as one of the latest methods of dealing with town sewage; this is a process of distillation, after treatment with lime and thorough putrefaction. He, however, confesses his difficulty, by wishing to reduce the sew-

* Read before the Chemical Section of the Glasgow Philosophical Society, April 19th, 1869.

age of this city from 31,000,000 gallons to 1,000,000 gallons daily. This, of course, requires a complete alteration in the existing system, and it still dilutes the excreta with more than ten times its bulk of water. The lime process, and the putrefaction required to decompose the urea, would be extremely offensive, and require vast storing tanks. In working 1,000,000 gallons daily (it would more probably amount to 2,000,000 gallons); he would have to treat 4464 tons daily, the total chemical (not the extractible) value of which is 2s. 6d. per ton; and he expects to do this with 20 tons of coal. He proposes to adopt an ingenious arrangement of eight boilers, steaming exhaustively, to distil off the ammonia, heating up the feed sewage, after precipitation by lime, by the hot water discharged from the boilers by a kind of brew-house refrigerator with its object reversed. He expects to distil off 1-12th; but I think it must be at least 1-10th, or 100,000 gallons, evaporated by 20 tons of coal =5,000 gallons to 1 ton. The report of Professors Lyon Playfair and Johnstone puts the average evaporation for Scotch coal at 7·7 tons, or 1712 gallons per ton, and at this rate 58 tons would be required for the mere evaporation. Then, for raising the heat, the same report says that 1 ton of Scotch coal raises 56 tons of water from 32° to 212° F., or, say, 50 tons of water from 52° to 212° F., requiring, therefore, 96 tons for heating up, making a total of 148 tons a day. Mr. Chapman, therefore, expects to save, by heating feed water, and by exhaustive steaming, a total of 128 tons of coal daily, or 600 per cent. Can this be done? If it can, then whatever may be the result of his process, as applied to sewage, it will make him the greatest and most daring authority on that equally important subject, the economy of fuel. He puts down no loss for radiation. This should, I think, be at least 10 per cent. which would require nearly as much as his total calculated expenditure for fuel. In using eight boilers, of 4,000 gallons each, he expects to get off all the ammonia in half an hour's steaming. Now, we all know that the estimation of free ammonia in the laboratory is one of the most tedious processes, requiring a long-continued ebullition, and the experience of distillers, on the large scale, amply corroborates this, and proves that it does not pay to distil liquors containing under 1 per cent of ammonia (some manufacturers double this estimate). The total amount in the sewage to be distilled would be under 0·2 per cent; I think, therefore, that the process of Mr. Glassford, of evaporation with sulphuric acid (for which I must refer you to his pamphlet on London sewage), is better than this; fuel is the great question in both, but in his the results are certain, in Mr. Chapman's they are problematical.

Both are, however, connected with the water system, which I believe to be a mistake, and I think we must ultimately come, either to a system like Capt. Tiernur's, by what may be called pneumatic despatch, or to the dry-closet system. Of the former I have fully treated in a former paper, and wish now to speak more particularly of the latter. During the past year, Moule's dry-closet has been largely introduced; all who have used it speak in the highest terms of its efficiency, and there are already strong indications of its becoming the system of the future. It is the only system that has succeeded during the hot fortnight at the Wimbledon meeting; and it is particularly adapted to hot climates, where the evils of the water-closet are most conspicuous. The objections urged against the system, when earth is used, are—1st, the large quantity of earth required—three and a half times the weight of the excreta; and, 2nd, the difficulty of obtaining the quantity required, and of drying it. Now, both these difficulties are disposed of by using charcoal. I employ, by preference, sea-weed charcoal, because it is the most porous, the best absorbent, and the cheapest. It only requires one-fourth of the weight, compared to earth; and when the mixture is removed and placed under cover, it soon dries. This mixture can be stored for any length of time, and used again several times. When convenient, it is re-burned, like the char in sugar refineries, except that this process is carried out in apparatus which admits of collecting the ammonia and other products condensed. The whole of the ammonia is thus collected; whilst the phosphoric acid, potash, and mineral matters accumulate in the charcoal, together with the carbon from the organic constituents of the excreta. The weight of the charcoal is increased to the extent of about 5 per cent with each using, and, if dried and re-used five times, about 25 per cent with each re-burning. With this constant addition, the char does not require replacing with fresh material, so that its cost is only a primary outlay—the ultimate result being that the excreta is deodorised by a charcoal derived from itself, and a company working this process would, in addition to securing the whole of the ammonia, become sellers of a charcoal second only in value to that from bones to the extent of, in Glasgow, if the process were general, 19 tons a day, or 6,935 tons a year; the total quantity of excreta which Glasgow has to remove being 385 tons a day, and its value, at 29s. 6d. per ton, =£569.* The ultimate result being the same, any charcoal may be used at first. The process is carried out without odour, from the closets to the finished products. Of course the process may be modified; for instance, suppose the char to be used five times, and only dried, the addition to its value would be as follows (I take equal parts, as this charcoal will absorb at least an equal weight of even urine):—

1 ton seaweed char, at £2 } =30 cwts. manure at £9 7s. 6d.
5 tons excreta, at 29s. 6d. } =£6 5s. per ton.

Or, if re-burnt, it would yield 25 cwts. of charcoal, and the whole of the nitrogen would pass over in the distillation, as ammonia. Dr. Wallace estimates the cost of re-burning char in sugar refineries at 3s. 6d. per ton for labour and fuel, containing 31 per cent moisture, which would be much over that referred to. Here, then, we have a simple process for recovering the whole of the value from excreta, of general application, and the results of which can be predicted by chemists with absolute certainty, as far as those products to which we at present attach value are concerned; but the uncertain portion is, as usual, the most interesting, for in the destructive distillation of excreta we are exploring a new field, which promises great interest.

I regret that I am obliged to bring this paper forward before the new products have been studied. The distillation generally is remarkably similar in its products to that of bones, and also to that, which most resembles it, of sea-weed. Besides ammonia, acetic acid, with a little butyric acid, acetone, and pyrrol are the most marked bodies. I cannot speak more definitely of these products in this paper, as they are still under investigation. The following analysis of urine is taken from Miller, representing the average compo-

* Value given in my former paper.

sition in 1,000 grs., sp. gr. 1,020. The calculated percentage of nitrogen is appended:—

		Nitrogen.	In 100 parts of solid matter.	Nitrogen.
	Water	956·80		
Solid Matter. 43·20. Organic, 29·97.	Urea 14·23	6·64	33·00	15·40
	Uric Acid 0·37	0·12	0·86	0·27
		6·76 = NH_3, 8·2. Sulphate of ammonia, 31·86, or 3·18 per cent.		15·67 = NH_3, 19. Sulphate of ammonia, 73·72.
	Alcoholic extract 12·53		29·03	
	Watery extract 2·50		5·80	
	Vesical mucus 0·16		0·37	
Inorganic, 13·35.	Chloride of sodium 7·22		16·73	
	Phosphoric acid 2·12		4·91	
	Sulphuric acid 1·70		3·94	
	Lime 0·21		0·49	
	Magnesia 0·12		0·28	
	Potash 1·93		4·47	
	Soda 0·05		0·12	
	999·94		100·00	

The average portion voided by each individual may be taken at 40 ozs., and of fæces, 4 ozs., total 44 ozs. daily; or, 1·7 ozs., solid, from urine, and 1 oz., solid, from fæces =total of 2·7 ozs. solid excreta daily. The following analysis of the fæces is from Berzelius:—

Water	75·3		
Bile 0·9			
Albumen 0·9			
Extractive matter 2·7	5·7	Solid matter, 24·7.	Containing, according to Playfair— 15 p. c. nitrogen, and 45 p. c. carbon, and about 25 p. c. ash. =nitrogen 3·75 p. c. =4·55 NH^3. =17·65 p. c. sulphate of ammonia. =70·71 in dry solid matter.
Salts 1·2			
Insoluble residues of digested food	7·0		
Insoluble matters added in intestinal canal—mucus, biliary resin, and peculiar animal fat	12·0		
	100·00		

The ash contains, according to Porter:—

	Ash of Fæces.		Ash of Urine (calculated).
Chloride of sodium	1·33	....	54·15
Phosphoric acid	36·03	....	15 89
Sulphuric acid	3·13	....	12·73
Lime	26 46	....	1·57
Magnesia	10·54	....	0·89
Potash	6·10	....	14·45
Soda	5·07	....	0·38
Peroxide of iron	2·50	....	——
Carbonic acid	5·07	....	——

Assuming, then, the proportions voided to be in the proportion of 17 dry, from urine, to 10 dry, from fæces, the resulting chars may be expected to have the following composition:—

	Urine.		Fæces.		Mixed Excreta.
Percentage of char in dry solid matter	50	..	70	..	57
Ammonia=sulphate	73·72	..	70·71	..	72·60

Composition of Chars.

	Per cent.		Per cent.		Per cent.
Carbon	33·33	..	45·00	..	37·65
Chloride of sodium	36·10	..	0·33	..	9·51
Phosphoric acid	10·60	..	9·01	..	10·01
Sulphuric acid	8·49	..	0·78	..	5·63
Lime	1·05	..	6·61	..	3·11
Magnesia	0·60	..	2·63	..	1·35
Potash	9·64	..	1·52	..	6·63
Soda	0·26	..	1·26	..	0·63
Peroxide of iron	——	..	0·62	..	0·23
Carbonic acid	——	..	1·26	..	0·46

The nitrogen in the mixed excreta, in the proportions voided, is equal to 4·49 per cent of sulphate of ammonia.

In the char from urine, the phosphoric acid is principally combined with potash, and therefore soluble. This char alone would be a valuable manure as containing a large proportion of soluble phosphates; but the result of commencing with seaweed charcoal, which is rich in carbonate of lime, will be to form phosphate of lime at the expense of the carbonate—in other words, to form, by treatment with urine, re-burning, and washing, the animal charcoal required by the sugar refiner. This expected result is verified in the following tables of analyses. I regard the phosphate of lime thus gradually formed, from its minute state of division, to be quite equal, in agricultural value, to ordinary soluble phosphate. The washed residual char from fæces is at once available for the refiner, as it contains about 26 per cent of phosphates of lime and magnesia, with but a small proportion of carbonate. I know no reason why the product of disintegrated bone and muscle should not be used for this purpose as well as the bones themselves.

In distilling 100 tons of the dry product from mixed excreta, therefore, we should obtain 72 tons of sulphate of ammonia, and 57 tons of charcoal, containing 10 per cent of phosphoric acid in its most available form for manure, and 6 per cent of potash. It will be seen, from Berzelius's analysis, that nearly 50 per cent of the fæces consist of fatty matter—how will this appear in the distillation? In a population of 500,000 this item amounts to nearly 7 tons a day!

I expected a loss of ammonia in drying, but it is very small, and appears to arise from the free lime in the char, as it will be seen further on that the loss decreases in using the char with urine. In a small experiment with urine, I found the total loss, in drying by artificial heat with new char, to be 2·06 per cent of the ammonia, or 0·105 per cent of the urine employed.

I append analysis of 1 lb. of char which was re-burnt fifteen times with an equal weight of urine; a portion of the char was lost, which prevents my giving the increase in weight; I believe, however, the addition of carbon would be too slight to effect an increase in the total, with so many re-burnings. The percentage is decreased:—

	Char used.		After re-burning.		Increase per cent
Water	10·0	..	2·80	..	——
Soluble salts	0·6	..	11·15	..	10·55
Insoluble	89·4	..	86·05	..	——
Soluble.					
* Chloride of sodium	——	..	8·75	..	8·75
Sulphuric acid	0·3	..	0·34	..	0·04
Phosphoric acid	——	..	2·00	..	2 00
Potash	0·3	..	2·40	..	2·10
Insoluble.					
Carbon	54·4	..	29·40	..	——
Silica, &c	9·1	..	13·10	..	4·00
Phosphate of lime	4·08	..	20 05	..	15·25
Carbonate of lime	17·4	..	19·75	..	2·35
Carbonate of magnesia	3·4	..	3·40	..	——

The urine used appears to have been deficient in sulphates and high in phosphates, these two ingredients being subject to considerable relative variation. The distillates gave 192 ozs. liquid, containing free ammonia equal to 3,047 grs. sulphate, or 2·9 per cent of the urine, showing a slight loss, inseparable from destructive distillations on the small scales. The charcoal

* In this and the following analyses, the whole of the chlorine has been calculated, for convenience, as chloride of sodium, which, in some cases, is therefore too high.

	Increase, per cent.				Increase, per 1,000 grs. of Urine.			
	1.	2.	3.	4.	1.	2.	3.	4.
Dry solid matter	33·30	62·50	210·00	347·94	33·30	31·25	42·00	34·79
Char	7·50	12·90	80·40	151·96	7·50	6·45	16·40	15·19
Ammonia sulphate	21·70	36·80	51·12	105·64	29·00	29·90	31·60	47·31

Residual Chars.

	Composition, per cent.					Increase, per cent.				Increase, per 1,000 grs. of Urine.			
	Ordinary Char.	1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.
Water	10·00	1·60	3·00	——	——	——	——	——	——	——	——	——	——
Soluble salts	0·60	15·80	19·80	39·40	52·20	15·20	19·20	38·80	51·60	20·40	15·70	24·30	22·78
Insoluble	89·40	82·60	77·20	60·60	47·80	——	——	——	*41·60	2·04	23·90	19·60	12·47
Soluble.													
Chloride of sodium	——	5·40	13·10	28·02	24·70	5·40	13·10	28·02	24·70	7·18	10·60	17·30	11·06
Sulphuric acid	0·30	2·05	3·29	3·77	3·77	1·75	2·99	3·47	3·47	2·33	2·64	2·21	1·62
Phosphoric acid	——	2·20	0·40	trace	1·60	2·20	0·40	——	1·60	2·92	0·32	——	0·71
Potash	0·30	2·80	4·99	7·00	10·38	2·50	4·69	6·70	10·08	3·32	3·89	4·10	4·62
Insoluble.													
Carbon	54·40	37·40	40·00	35·40	28·20	——	——	——	*26·20	*4·50	5·30	11·06	7·19
Silica, &c.	9·10	13·60	10·00	8·00	4·40	4·50	0·90	——	*4·60	8·98	3·57	3·14	1·06
Phosphate of lime	4·80	8·00	9·60	11·40	10·20	3·20	4·80	6·60	5·40	5·84	5·40	6·10	4·08
Carbonate of lime	17·40	20·40	13·20	4·20	1·15	——	——	——	*16·25	9·73	2·00	*0·88	*1·22
Carbonate of magnesia	3·10	5·40	3·16	1·93	1·20	2·30	0·06	——	*1·90	4·08	0·98	0·57	0·23

Washed Chars.

	Composition, per cent.					Increase, per cent.			
	Ordinary Char.	1.	2.	3.	4.	1.	2.		
Carbon	54·40	45·30	51·80	58·40	59·40	9·10	*2·60	4·00	4·60
Phosphate of lime	4·80	9·60	12·40	18·80	21·34	4·80	7·60	14·80	16·54
Carbonate of lime	17·40	24·60	17·10	6·90	2·40	7·20	*0·30	*10·50	*15·00
Carbonate of magnesia	3·10	6·50	4·10	3·10	2·51	3·40	1·00	—	*0·59

* Decrease.

should be used at least five times before re-burning, and for urine alone it may be employed ten times. I append a table, showing the analytical results of this process with urine.

No. 1 is from charcoal dried up with ten times its weight of urine before re-burning; No. 2 has been treated with twenty times its weight, No. 3 with fifty times its weight, and No. 4 with 100 times its weight of urine before re-burning. It will be seen, that in No. 4 more than the theoretical amount of ammonia is obtained; that from Nos. 1, 2, and 3 are obtained by simple destructive distillation. No. 4 only yields ammonia equal to 50·48 per cent of sulphate when heated in this way, the quantity given, 105·64 per cent, being that obtained with soda-lime; the residual nitrogen is not left in the char, but goes off in the distillation in some other form than ammonia. I shall recur to this subject in a subsequent paper. The retention of nitrogen after drying is, however, extraordinary when the product yields ammonia equal to 105 per cent of sulphate. No Peruvian guano can be compared to this in fertilising value.

The washed chars acquire the composition which fit them eminently for the sugar refiner.

The experiments with closet excreta are unfinished, and it is difficult, in working on small quantities, to obtain uniform results. We find one of Smith's dry-closets use ½ lb. of seaweed char per charge, the charge of dry earth being 2 lbs. Moule's closet uses rather less. There were seven uses in our first experiment, the contents of the pail being re-burnt at once, without drying.

Weight before distillation	130 ozs.
Residual char weighed	48 "
Weight of excreta 82 ozs. = 11·7 " per use.	

The distillation gave 66 ozs. of gas liquor containing free ammonia = 1·8 ozs. sulphate = 3·4 per cent of mixed excreta; this represents only the free ammonia, or that existing as carbonate; a portion is combined with acetic acid, which was not estimated.

The same method is equally well adapted for treating pot ale from distilleries, and blood and offal from slaughter-houses. The former is an important subject in Glasgow, and I can in this paper only shortly allude to it. According to Dr. Wallace, one of the distilleries in Glasgow sends into the sewers 83,000 gallons of this pot ale, containing nitrogen equal to 118 grs. of ammonia per gallon; so that the daily discharge of this one distillery is equal to the total excreta of 48,970 persons, or one-tenth the population of Glasgow.

The process can be adapted with ease to urinals as well as closets. I am enabled to exhibit some mixtures of charcoal and night soil made twelve months ago. I was curious to know if these mixtures had gone further in the oxidation of the ammonia, and formed some nitrates, but not a trace can be detected.

I submit that the dry-closet system, with this process, has the following great advantages:—

1. Total freedom from all odour. All must have noticed sometimes the sickly odour of a water-closet, arising, not from the excreta, but from the gas from the sewers.

2. Certain prevention of all contamination and spread of infectious diseases arising from sewer leakage into our wells or sewer gas into our houses.

3. Saving of water, equal, in Glasgow, to £40,000 a year, if the water-closet system were general.

4. Saving of expense in repairs and removal. 1 cwt. of charcoal per month is sufficient for each closet when used by six persons daily, and the whole may be allowed to fall at once from the closet, through a 12-inch pipe, to a cesspit below the house. A cess*pool* is a serious evil, but I know of no evil to a cess*pit*.

5. By this process alone can the whole of the valuable material be recovered for our lands.

Dr. Fergus has shown some remarkable examples in which gastric fever has been traced to the escape of sewer gas through small openings eaten through the top of the soil-pipe. This appears to be a wide-spread evil. I have examined some of these specimens, and find the substance to be a sort of lead plaster, containing, also, lime and some fatty acid, which requires further examination. I have shown that only remedial measures can be adopted, where the water-closet system has been carried out, by placing boxes of charcoal in the closets, and filtering the sewage through charcoal before allowing it to enter rivers.

Our authorities want, of course, some grand scheme; but they forget that the question is one of minute details. We are assailed by a large army of small nuisances—one, at least, to every house, and we must attack them one at a time. Attacked in their united strength, they will assuredly overcome us. Ought we not rather to strike at the root of the evil? Ought we not to stop the mischief at its numerous sources, and before these can combine into a mighty force, which carries everything before it?

Let the subject be calmly and carefully discussed; let us not be carried away by great schemes and useless expenditure; let us not leave to posterity heavy taxes, with barren wastes and desolate cities, but let us rather pay our own way, and leave our country fertile and our towns pure, and I shall never regret that, however imperfectly this subject has been brought before you, my earnest wish has been to strike "one more blow for life."

A lively discussion followed the reading of the paper, the general opinion of the members of the section being highly favourable to the process, which was considered the most novel and practical which has yet been introduced.

ON THE FUNCTIONS OF NUCLEI

WITH RESPECT TO GASEOUS, SALINE, AND VAPOROUS SOLUTIONS.*

BY CHARLES TOMLINSON, F.R.S., F.C.S.

As every one here present is engaged in conducting processes in chemistry and pharmacy, you will, I am sure, be interested in some new experiments connected with the solution of gases, crystallisation, ebullition, and distillation, which I shall have the honour of performing before you.

You know that when a bottle of soda-water is emptied into a glass, there is not only an escape of gas from the surface of the liquid, but innumerable bubbles become attached to the inner surface of the glass. A crumb of bread, thrown into the soda-water, produces a lively effervescence; and, if we put into it the finger, a strip of paper, a rod of glass, of metal, or of wood, it immediately becomes covered with gas. In fact, any solid acts as a *nucleus* in separating gas from solution; and I would define a nucleus as a body that has a stronger adhesion for the gas of a solution than for the water which holds the gas in solution.

Let us now take a glass that has been made chemically clean by being washed out with strong sulphuric acid, or caustic alkali, and copious rinsing with clean water. If the soda-water be poured into this, the results are very different. After the very first effervescence is over, the glass looks as if it were full of pure distilled water, not a bubble of gas is to be seen adhering to the sides, and there is no appearance of gas anywhere about it. I plunge into the liquid a glass rod that has been made chemically clean, or *catharised* as it may be called: there is no escape of gas, not a single bubble adheres to the glass rod. I put in clean iron filings: there is no liberation of gas. I pour some iron filings into my hand, and rub them about, and, on putting these into the soda-water, there is a furious, boiling effervescence.

Hence, you see, there is a marked distinction between a clean or *catharised* body, and an unclean body, or *nucleus* as it may be called.

The action of nuclei may be similarly traced in the case of certain salts that form supersaturated solutions. For example, 100 parts of water, at 212° F., will take up 357½ parts of potash alum; whereas, at 32°, the water will take up only 3·9 parts, and yet the solution, saturated at 212°, may be cooled down to 32°, without any separation of the salt, provided the vessel containing it be chemically clean, the solution clean, and means be taken to exclude the dust of the air. Such a solution is said to be *supersaturated*, because it holds more salt in solution than it can take up at the reduced temperature. In the case before us, a solution of alum, saturated at 212°, and cooled down to 32°, contains 90 times more salt in solution than it can take up at 32°. Here is a solution of alum, saturated at 194°, and containing 53 times more salt than the water, at 32°, can take up. You see it is a perfectly clear and bright solution, and may be shaken with impunity. It remains liquid and supersaturated simply because there is no nucleus to start the act of crystallisation. I take out the plug of cotton-wool from the flask; and you see how beautifully the surface of the solution becomes covered with a crystalline crust, while well-shaped octahedra grow downwards, until the whole mass is solid, and the flask quite warm from the heat developed by the change of state.

Here is a supersaturated solution of sodic sulphate in a narrow-necked flask. I take out the cotton-wool, and the solution does not crystallise; I touch the surface of the solution with a glass rod, and crystallisation instantly sets in.

Here are similar solutions of sodic sulphate and sodic acetate, each containing a solid, such as a bit of charcoal, of pumice-stone, of meerschaum, of coke, &c. These bodies, which would act as nuclei in inducing crystallisation if put into the cold solution, become inactive if boiled up with the solution, and allowed to cool down with it and in it; they are, in fact, chemically clean. I take the cotton-wool out of these flasks; some of the solutions will crystallise on the instant, others after a short time, others, again, after some hours. It depends very much on the size of the opening whether a speck of dust enter the flask; for, of course, the wider the opening, the more likely is it for the dust to find an entrance.

In the case of saline solutions, a nucleus may be defined as a body that has a stronger attraction for the salt of a solution than for the liquid which holds it in solution.

In general, a body that has been exposed to the air, or handled, or wiped with a cloth that has been

* A lecture delivered at the *conversazione* of the Pharmaceutical Society, May 18th, 1869. Communicated, with additions and corrections, by the author.

handled, is covered with an oily, fatty, or greasy film, to which the water of the solution adheres either not at all, or less strongly than does the salt of the solution, and, hence, such a body introduced into the solution acts as a nucleus. Make the body chemically clean, and the solution adheres to it as a whole; that is, there is the same amount of adhesion between the nucleus and the water of the solution as there is between the nucleus and the salt of the solution, and, hence, there is no separation.

An extreme case of this kind of perfect adhesion on the part of chemically-clean surfaces and the solutions, may be seen in this flask. It contains a highly-supersaturated solution of sodic sulphate, resting upon a considerable mass of the modified 7-atom salt. This, being chemically clean, does not act as a nucleus to the rest of the solution. I can shake the flask violently, so as to break up and rattle about these crystals at the bottom, and the solution does not solidify. But now, look at this: I take out the cotton-wool, and, instantly, lines of crystals, closely packed together, diverge from some point on the surface, and the whole saline contents of the flask form one solid mass.

This differential kind of action which belongs to nuclei, may also be exhibited with reference to liquids at or near the boiling point. My definition of such a liquid is, that it is a supersaturated solution of its own vapour. It is a solution of vapour, constituted like the solution of carbonic acid in water, or of sodic sulphate or of alum in water.

Such being the case, a body introduced into a liquid at or near the boiling point acts or does not act as a nucleus in separating vapour, according as it is unclean or clean. If clean, the solution adheres to it perfectly, and there is no separation of vapour; if unclean, the vapour adheres to the surface as strongly as before, but the liquid adheres less strongly, or not at all, and, hence, there is a separation of vapour on the surface of the nucleus.

Now, you are all acquainted with a very unpleasant phenomenon that often accompanies the processes of boiling and distillation. I mean the *bumping* of the vessel, or *jumping ebullition*, as it is called (*soubresauts*, in the language of French science). This is generally brought about thus:—The liquid makes the interior of the vessel chemically clean, and the solution of vapour adheres to the clean surface with great force; the temperature rises above the boiling point, until the liquid not being able to dissolve any more vapour, a portion of the latter escapes with a burst along the line of least resistance, or towards the opening of the vessel. This upward action is accompanied by an equal reaction in a contrary direction, which tends to force the retort or flask further into the ring of the retort stand, or down upon any other support, and it is the rebound from this that causes the *soubresaut*. Now, for the purpose of preventing or mitigating this inconvenient and even dangerous action, it is the practice to introduce into the vessel certain angular or rough bodies, such as sand, pounded glass, bits of tobacco pipe, platinum, copper, &c. Such bodies have been called "promoters of vaporisation." How they act has not been explained, but it has often been noticed that they cease to act in liberating vapour after prolonged contact with the boiling liquid.

I need scarcely say that such bodies cease to act as nuclei in liberating vapour from solution as soon as they become chemically clean.

Now, here is water boiling in a clean flask with some difficulty and a disposition towards bumping. I put into the flask a pinch of sand from the sand bath, and the boiling immediately becomes soft and regular, and there is no tendency whatever to bumping.

But suppose we make the sand chemically clean, by heating it in contact with strong sulphuric acid, rinsing with water, washing with alkali, and again rinsing. Such sand, in very small quantity, in a chemically-clean flask containing clean distilled water, will increase the bumping to a remarkable extent. Here is such a flask, standing over a spirit lamp. You see that it bounds up from the support with explosive force, and one wonders the flask is not shivered to pieces. The bits of glass, &c., put into a retort containing alcohol, ether, &c., soon behave in this way, for the liquid makes them, as well as the interior of the vessel, chemically clean, and, in such case, we multiply the adhesion surfaces, when what is wanted is an extension of the vapour-giving surfaces.

It is clearly wrong to employ as nuclei bodies that soon cease to act as such, supposing it were possible to find permanent nuclei. Porous bodies, such as charcoal, coke, pumice-stone, &c., perform this useful function. The same force which enables a piece of boxwood charcoal, for example, to absorb 95 times its volume of ammoniacal gas, causes the charcoal, in the midst of a hot solution of vapour, to absorb vapour, and, under the continued action of heat, to give it out again, in a constant, never-ceasing flow.

Indeed, what is remarkable is the permanent action of these porous bodies. I have tried the same piece of charcoal or of coke in boiling liquids over and over again, for weeks together, and never found the vapour-giving action to flag. I have boiled these porous bodies in strong acids, washed them in alkalies, and made them in all respects chemically clean, without at all interfering with their vapour-separating action in boiling liquids. They do not act as nuclei in separating salt from solution if boiled up with it and allowed to cool in it; their peculiar function is to separate vapour from liquids, at or near the boiling point; and this they do by their capillarity. I have, in this flask, a bundle of glass capillary tubes, united like a faggot, by means of a thread in the middle. This acts vigorously in separating vapour from the liquid at the boiling point, and, even after the lamp has been removed from under the flask, the tubes continue for some time to discharge vapour from their ends.

Among the charcoals, the most efficient as a vapour nucleus is charcoal from cocoa-nut shell. This is very dense, and sinks below the surface of liquids denser than water, which is a great advantage.

It will, I think, be worth your while to come up, after the lecture, and watch closely this large flask of water, containing some pieces of cocoa-nut shell charcoal. The vapour passes off from each piece in perfect torrents, and there are these two remarkable advantages connected with the action, namely, bumping is entirely prevented, and the amount of distillate is largely increased, in some cases as much from 30 to 50 per cent, with the same amount of heat, in the same time, as compared with the process without the use of the charcoal.

For example, methylated spirit of wine, boiling at 171° F., was distilled in a glass retort. The distillate collected in five minutes weighed 244 grains. Three or four fragments of charcoal, partly boxwood and partly cocoa-nut shell, weighing only 20 grains, were added to the retort. The distillate, in five minutes, was now

325 grains. The ratio of the results is 100 : 133·2. With 20 grains of pumice-stone, the results were as 100 : 121·7; with 20 grains of meerschaum, as 100 : 112; and with 20 grains of coke, as 100 : 107·46.

But these results are understated; for the retort contained some porous specks of iron or charcoal, which get attached to most glass vessels during the process of manufacture, and which act as powerful nuclei in separating vapour from boiling liquids. Indeed, were it not for these accidental impurities, many a chemical operation must fail from excessive bumping.

But, as I promised to make this a short lecture, I must conclude. You see that there is a harmony of action in the behaviour of nuclei with regard to gaseous, saline, and vaporous solutions; and, from this action, we get a clear view of the functions of nuclei, and also get rid of much speculation as to "molecular action," and "the mysterious action of the air," which some observers indulge in when treating of supersaturated solutions.

DECOMPOSITION OF REFRACTORY SILICATES BY FLUORIDES IN THE WET WAY.

BY CHARLES E. AVERY,

STUDENT IN THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

I find that silica and silicates, such as felspar and glass, may be completely dissolved in the cold by a mixture of some normal fluoride with almost any of the stronger acids, whether concentrated or dilute.

When mixed with the fluorides of sodium, barium, aluminum, lead, or the double fluorides of these metals, the silicates in question can be readily decomposed by nitric, chlorhydric and sulphuric acids, either concentrated or diluted with four volumes of water.

If strong sulphuric acid is used, a part of the silicon passes off as gas; if the dilute acid is used, portions of many silicates remain undissolved as insoluble sulphates.

The same decomposition of the silicates is effected, though less easily, by the action of oxalic, acetic, tartaric, and like acids, on the mixed fluoride and silicate. Carbonic acid, even as dilute as in the air, does the same thing, but less rapidly.

Strong nitric acid gives a perfect solution and acts rapidly, dissolving a moderately fine powder of felspar or quartz in a few hours even in the cold. The loss of silica is very slight if the experiment is properly conducted; hence, all the constituents of a siliceous mineral can be estimated in the solution produced.

In analysing the silicates in this way, it is best to use the fluoride of some metal which is not to be estimated in the analysis; since, if we use a fluoride whose metal is present in the mineral, we must know the weight of fluoride taken. Of the various fluorides those of barium and lead seem to me the most promising.

An objection to the use of fluoride of ammonium is that, as usually made, it contains sulphate of ammonium, so that insoluble sulphates might be formed and solution retarded.

If fluoride of sodium, as made from cryolite, were not so hard to purify, it would be well fitted for the analysis of silicates free from sodium.

It has long been known that acid fluorides attack the silicates, and that even acetic acid can change normal into acid fluorides; but, so far as I know, no one has before shown that the action of acids is sufficiently rapid and complete, in the cold, to be useful in analysis. In another paper, I shall give the details of the process of solution, the method of analysis, and the means of making the fluorides.

Boston, February, 1869.

CHEMICAL EXAMINATION OF THE ORIENTAL JARGON.*.

BY DAVID FORBES, F.R.S., &C.

A short time back, I undertook, at the request of Mr. Sorby, to prepare for him some of the earth or earths which, in combination with silicic acid, formed this gem, and as the means I employed in so doing appeared to throw some little light upon the characters of the earth hitherto regarded as zirconia, I have thought that a notice of the results obtained by me might not be devoid of interest.

The jargon employed was in fragments, being part of an almost colourless crystal, forwarded to me by Mr. Sorby, who had previously found, by optical examination, that it showed with great distinctness the peculiar and characteristic spectrum which he ascribes to the presence of the new element jargonium, and noticed that the bands became much more pronounced after ignition and cooling.

The fragments, which were extremely hard, were broken up in a diamond mortar, previous to being reduced to as impalpably fine a powder as possible in an agate mortar; 16·22 grains of this powder were then thoroughly mixed with 81 grains pure anhydrous carbonate of soda, placed in a platinum crucible, and fused at the highest heat of a large air gas blowpipe jet, after having been previously kept for two hours over a powerfull Bunsen's flame, so as to "frit it," or ensure combination previous to fusion. After complete fusion, a small lump of pure hydrate of soda (about 15 grains) was, as recommended by Berzelius, carefully deposited in the centre of the fused mass, and a second similar piece added after the first had been absorbed; the fused substance became much more liquid after this addition; the heat was kept up for another half hour longer, and the whole was allowed to cool.

By the above means the mineral was perfectly decomposed, and the silica so altogether transferred to the soda that it could be completely removed by cold water, leaving no trace behind with the earths. Previous experience with the zircons from various localities, and hyacinths from Ceylon, had proved to me that the perfect decomposition of these minerals is often attended with considerable difficulty.

The fused mass when cold was treated repeatedly with cold water in a silver vessel, decanting off the supernatant solution each time, until the silica was entirely removed, and a white powder, probably a compound of the earth with soda, remained behind.

The solution which contained all the silica was acidified with hydrochloric acid, evaporated to dryness, and the silica determined as usual. The silica obtained weighed 5·45 grains, consequently was equivalent to 33·61 per cent in the mineral.

The white insoluble residue previously mentioned, was found to be perfectly soluble in hydrochloric acid; in order to test if it contained any silica, the solution was evaporated to dryness and re-dissolved in water

* Although in commerce this mineral is generally known as the jargon from Ceylon, the name Oriental jargon seems to me to be preferable, since it appears uncertain whether these stones are actually found in the Island of Ceylon, that place being well known as the principal Eastern mart for precious stones procured on the mainland of India and the adjacent countries.

acidulated by HCl, but left no trace of insoluble matter behind. From the colour of the solution being distinctly yellow, it evidently contained oxide of iron, which I had scarcely expected, since the original mineral was nearly, if not altogether, devoid of colour; the solution, consequently, was a chloride of the earths of the jargon, accompanied by some sesquichloride of iron.

Berzelius many years ago devised a means of separating oxide of iron from zirconia, founded upon the behaviour of their respective chlorides, the sesquichloride of iron being soluble in strong hydrochloric acid, whilst that of zirconia is nearly insoluble; I had tried this process previously with zirconia from Ceylon hyacinths, and had not been satisfied with it, as the iron solution carried along with it a not inconsiderable portion of the earth. It now struck me, however, that possibly the earth so dissolved might differ in character from that contained in the insoluble chloride, and I therefore determined to make the experiment.

The hydrochloric acid solution was consequently again evaporated until it solidified as a yellow saline mass, whereupon it was treated repeatedly with cold strong hydrochloric acid of density 1·138, allowing it to stand some time and decanting the solution as long as the fresh acid acquired the faintest yellow tinge. A yellow solution was obtained, leaving behind a snow-white chloride, crystalline in appearance and completely soluble in water, forming a perfectly colourless solution. From this solution ammonia precipitated a flocky, but apparently rather dense, white precipitate, which, after being thoroughly washed, dried, and ignited, was of a pure white colour and possessed a peculiar waxy look and dense appearance; it weighed 7·48 grains, and consequently amounted to 46·12 per cent of the jargon examined.

This earth was examined optically by Mr. Sorby, and, according to his account, did not give a trace of the characteristic jargonium bands in the spectrum, and it was, therefore, concluded to be pure zirconia.

The yellow hydrochloric acid solution was now examined, and found, besides sesquioxide of iron, to contain a considerable amount of an earthy base, like zirconia. I decided to separate the iron by the tartaric acid and sulphide of ammonia process recommended by Berzelius, and, consequently, the solution was first supersaturated by ammonia, which threw down a faint yellowish white somewhat flocculent precipitate. Tartaric acid in excess was then added, which dissolved at once the greater part of the precipitate, but, notwithstanding that a very large excess was added, a portion of the precipitate refused obstinately to re-dissolve, even upon application of heat. In order to examine this, the solution was filtered: a white, flocculent, and somewhat glutinous substance was left upon the filter, which, when well washed with hot water, dried, and ignited, weighed 1·24 grains, equivalent to 7·64 per cent of the original mineral.

This body, after ignition, appeared very different from the previously-obtained zirconia; it was a white powder, but did not aggregate together or form lumps having a waxy lustre on the surfaces of fracture; on the contrary, it was more pulverulent, had a dead white, or mealy, appearance, and did not appear to be of any great density.

From Mr. Sorby I learn that it gave the spectrum of jargonium with intensity, and he concludes that it must probably be its pure oxide or jargonia.

Ammonia was now added in excess to the tartaric acid solution, which remained clear. Upon the further addition of sulphide of ammonium, the solution assumed a dark brown coloration; but no precipitate separated before the lapse of some days, when a black deposit of sulphide of iron formed, which was collected upon a filter, after the greater part of the supernatant liquid had been carefully syphoned off.

This sulphide of iron was converted into sesquioxide, and afforded 0·04 grain, equivalent to 0·24 per cent in the mineral.

After separation of the iron, the solution was evaporated to dryness in a platinum capsule, and ignited for some time, to drive off all ammoniacal salts, and oxidise the carbon resulting from the decomposition of the tartaric acid. There then remained behind an earthy body, of a white colour, having a slight tinge of grey, which weighed 2·03 grains, or 12·52 per cent.

In appearance, this earth was quite different from the zirconia, and more resembled that supposed to be jargonia. Mr. Sorby, upon optical examination, reports that "It seems to contain a good deal of zirconia and a very decided trace of jargonia, but I am very much inclined to suspect that it may contain some other substance. Its behaviour with borax before the blowpipe is very different from that of the zirconia from the jargon, and it turns extremely opaque, and a sort of orange-yellow, by transmitted light." Possibly this substance may contain a third earth analogous to zirconia, such as Svanberg (*Ofversigt. Kongl. Vet. Acad.*, pp. 34, 37, 1845) suggested was present in eudialite and certain zircons.

The result of this examination of the jargon, when summed up, indicates its composition to be as follows:—

	In 16·22 grains.		In percentage.	
Silica	5·45		33·61	
Zirconia *a*	7·48	10·75	46·12	66·28
" *β* (jargonia?)	1·24		7·64	
" *γ*	2·03		12·52	
Sesquioxide of iron	0·04		0·24	
	16·24		100·13	

The formula ZrO_2SiO_2 ascribed to zircon requires—

Silicic acid	33·77
Zirconia	66·23
	100·00

with which the numbers found for jargon are closely approximative.

The results of this chemical examination must be considered as strengthening the evidence, physical and chemical, that the earth usually denominated zirconia is, in reality, a compound of two, if not more, closely-allied oxides. In 1845, Svanberg announced that the zirconia contained in the various zircons from Siberia, Norway, and Ceylon, as, also, in the hyacinths from Expailly and Ceylon, was a compound of two or more earths, one of which he termed noria; and, in a subsequent paper the same year, also found this to be the case with the earth in the Greenland eudialite. His arguments—for he did not succeed in separating the earths—were founded upon his observations that the salts of zirconia did not always contain the same constant proportion of acid to base; that the oxalates, chlorides, and sulphates differed in their behaviour and solubility in certain reagents, and that the specific gravities of the natural silicates (zircon) from various localities differed greatly from one another.

These observations of Svanberg, notwithstanding the promise contained in his short paper on the subject to bring forward fuller evidence, have, as yet, never been

followed up by him, and the subsequent researches of other chemists appear to throw doubt as to their correctness in several points, as well as to render the existence of his noria extremely dubious. The researches of Berlin (*Journ. f. Prak. Chemie*, lviii., p. 145, 1853) showed that the results of the fractional precipitation of chloride of zirconia by oxalic acid did not warrant the conclusions of Svanberg, and that the zirconia prepared from zircons from Frederiksvaern, Expailly, Ural, India, and from the Ceylon hyacinths and Norwegian katapleeite, behaved in similar manner with oxalic acid, and that their oxalates were easily and completely soluble in excess of that acid, and that the specific gravity and amount of zirconia obtained from the oxalates from Frederiksvaern zircon and katapleeite which he examined were identical, so that it would seem necessary to seek for some other means of separating the earths than by the employment of oxalic acid. In some experiments I made for the purpose of attempting to isolate noria (in which I used Norwegian zircons from two different localities, and also hyacinth from Ceylon), I failed in so doing, but corroborated the results obtained by Berlin.

In 1864, Nylander, in a paper, "Bidrag til Kännedomen om Zirkonjord" (*Acta Universitatis Lundensis*, 1864), has examined the zirconia from the Norwegian eucolite, and considers that it contains two earths, which differ in their behaviour and solubility of their double potassium sulphate salts, but he also appears to have come to no definite results as to the existence or isolation of the earths themselves.

It is to be hoped, however, that the interest now excited by Mr. Sorby's announcement of the existence of argonium will induce chemists to work the subject out in more detail.

ON THE

EXAMINATION OF WATER FOR ORGANIC MATTER.*

BY R. ANGUS SMITH, PH.D., F.R.S., &C.

In 1865 I received a request to write on the organic matter of water. I wrote a memoir, which was, without intending to be published, extensively circulated among officers of health, especially in India.

I there made a division which was entirely new to chemists. The substance styled "organic matter," instead of being given as one to which little or no definite meaning was attached, was considered as existing chemically under at least seven different headings, not forgetting the numerous organised forms which it might assume. These divisions were—

1st. The organic matter decomposed, or putrid.
2nd. Organic matter readily decomposed, and probably ready to become putrid.
3rd. Organic matter slow to decompose.
4th. Recent organic matter.
5th. Old organic matter.
6th. Vegetable organic matter.
7th. Animal organic matter.

The first was known by the gases which instantly decomposed permanganate.

The use of the permanganate of potash, recommended by Forchhammer for ascertaining the organic matter of water, has been tried and admired by some, and found entirely wanting by others.

I endeavoured to show, in the memoir alluded to and in a subsequent paper, how far that salt could be trusted; quite certain of its value for ascertaining bodies of the first and second classes, but having no experience of my own which would guide me to consider it a sufficient test for the total quantity of organic matter.

Bodies of the third class I was therefore inclined to estimate quantitatively by drying and weighing, afterwards ascertaining the condition of the matter as the point of most importance.

Organic matter of the fourth class was estimated by the amount of nitrites in the water, because their existence showed that the matter was oxidising, but had not had time to complete the action.

Bodies of the fifth class were estimated from the nitrates, as in that case the action was finished.

Bodies of the sixth class were reckoned from the absence of bodies of the seventh class, which latter class, again, were considered to exist when they were accompanied by an unusual amount of chlorides, supposing care to be taken to discover that other sources of chlorides did not exist.

It is not to be expected that any of these divisions should be sharply defined; but the one most difficult to decide upon, to all appearance, is really that which I have found, with proper precautions, scarcely ever to fail me, though it has been used in hundreds of instances, and for many years—namely, the test for animal matter.

Dr. Woods had written on the use of Forchhammer's chameleon previous to the publication alluded to, and about the same time Prof. W. A. Miller; but I am not aware that any one endeavoured to distinguish the various conditions of the organic matter. I am, and was, desirous of showing that organic matter is not necessarily hurtful; we speak of it in water as an evil, to be measured by the balance, whilst there is as much difference in the qualities of that found in water as there is between good wholesome meat and putrid flesh.

I was desirous also of showing the true value of the permanganate, which is capable of acting on one, but scarcely on the other, and of being used for analysis for sanitary purposes, although not for all the demands of the chemist.

Dr. Frankland next took up the subject, and proceeded to show the amount of organic matter, or of sewage matter, which might flow into a stream; and this he did by estimating the nitrogen gas obtainable from the organic matter of the water. By ascertaining the amounts existing in the water supplied to a town and flowing in the sewage, he found the total thrown out by the inhabitants.

For this he made an organic analysis of the residue of the water, and by a very beautiful arrangement, using Sprengel's pump, he drew out the nitrogen for measurement. I do not doubt that this mode adopted by Dr. Frankland will always be useful, and will remain permanent as a method, but not for constant use, on account of the time required, excepting by those chemists who perform many of such analyses, and have the apparatus in constant readiness. It is, however, always pleasant to find an addition made to our capacity for accuracy, and especially when such beautiful methods are employed.

By this means Dr. Frankland obtains the organic nitrogen, nitrates and ammonia being removable. I have not generally estimated the latter, as being still

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* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations by the author.)

more unstable than the former, and I have frequently found it to disappear with great rapidity, affording by no remnant any clue to the past. Urea and uric acid must also be excluded from the organic nitrogen before we obtain a clue to the albuminous matter. I think, however, that we require to know, above all, whether this matter is in a state to putrefy, or to produce living forms. If there are organic germs capable of development in a visible form, that condition ought not to be neglected.

Immediately, I believe, after this plan was adopted by Dr. Frankland, Mr. Wanklyn discovered a mode of decomposing albumen by permanganate of potash, obtaining ammonia.

This process was used by Messrs. Chapman and Miles Smith. I shall not attempt here to give the exact amount of honour due to those gentlemen, or to tell precisely the boundaries of their labour.

The result seems to be, that the nitrogen may be obtained without the trouble of the usual organic analysis, although it may be uncertain which process takes the longest time.

Mr. Wanklyn considers that he can, by his method, first remove the ammonia which exists as such, by boiling with carbonate of soda; next, by decomposing the albumen with permanganate of potash and boiling in caustic potash, obtain the ammonia resulting from the decomposition. This is a decided gain to us, and may turn out to be the normal mode of separating the ammonia of the putrescible and unputrescible organic bodies.

We are rather apt, when we find a method of analysis, to look at it as final. I shall endeavour to show how much we obtain by Dr. Frankland's method, and how much by Professor Wanklyn's. I shall perhaps, also, as in such cases, be inclined to show that my own method reveals a greater amount of the peculiarities of water. It makes more divisions, is more complicated therefore in one respect; but every point tells its own tale, and it is the number of tales we have to tell regarding the history of water that measures the fulness of our reports. I shall probably adopt all the methods for a time.

In the paper mentioned, I pointed out the error of supposing that organic matter was all equally unwholesome, or that it was, in all cases, even in the slightest degree so. It was the custom too much to confound the simplest peaty and the most noxious putrescible matter. On this subject I may here quote the paper.

"*Quality of the Organic Matter.*

"Water manifestly containing organised matter is to be avoided; but it may frequently be purified by some mechanical mode of separation, such as simple straining.

"If the water contains organic matter in solution, or a condition approaching in all appearance to solution, it may be wholesome or unwholesome. The mere existence of organic matter is no proof of impurity. We must know if it brings animalculæ or vegetable life or products of putrefaction. We must know the *quality* as well as the quantity. If the matter is peaty, consisting of the ordinary humous class of acids and salts, the colour may be very dark and the water very unpleasant to look at, without being in any way, so far as I have ever heard, injurious to health, although such water cannot be quite so wholesome as pure water, since the oxygen of solution is diminished. The taste and other sensible qualities will be the chief guides.

"If the matter is wholly or nearly colourless, it may still be wholesome or unwholesome. It may, for example, contain the juices of plants of a wholesome character. If these juices are fresh, they may do no injury; but they will not long remain fresh, they will putrefy. Water containing organic matter ready to putrefy ought to be avoided, as we cannot tell when the moment of danger begins; whilst the quality at best is never known to us exactly.

"To ascertain the nature of the organic matter, the water is allowed to stand for a day or two, in which case it may be found that organised bodies show themselves.

"Sometimes plants seem completely to fill the vessel, having come out of a moderately clear solution. When standing, in this case, the water must be prevented from evaporating, and it must be in glass, so as to be exposed to light; a temperature suiting vegetation is also to be given. Animalculæ may appear in great numbers; they are an indication of nitrogenous matter, and one proof of the presence of substances capable of putrefaction. It may be that some form of putrefaction will be the only result; but whether this occurs alone, or along with organised forms, an excess of organic matter is proved.

"Water that will not bear the test of standing will in most cases be rejected at once. If no other can be obtained, it ought to be used before the putrefactive process has begun; but this is very dangerous. The next best method is to wait till after putrefaction has terminated, and the products are separated as much as possible. This is popularly known to be the case when the water has for some time become clear and colourless, and free from smell and taste. There are some difficulties connected with this. Water undergoing putrefaction is manifestly unwholesome. After putrefaction is completed, it may be quite wholesome. Although the process is proved by Pasteur not to begin without the aid of organic germs of some kind, they seem to be of a class constantly existing in the atmosphere, even when it is wholesome, whilst we have reason to believe, from the results, that germs of disease, if there are such, are decomposed, like other albumenoid substances, during the action. It would, therefore, be probably safer to wait till putrefaction was completed, but this is often tedious. At any rate, it was intended to state that, when activity began, it was not safe to use the water. The points of safety and of danger require investigation.

"Water with green organic matter in suspension or semi-solution is generally full of germs of living things, and nauseous to the taste.

"A microscope is very useful in detecting the smaller forms of life, but not always essential. Good water is clear and colourless, or only slightly browned by peat. Clear bright water shows no microscopic objects. It is quite a mistake to suppose that all water contains animalculæ. Those who have sent abroad this saying could not have known what pure water is.

"If the signs of organic matter are clear, it may not be needful to go further, but to reject the water at once. After standing for two or three days, varying with temperature, and showing nothing to the eye except a little film of green on the bottom of the vessel, we may conclude that not much organisable matter is there. We may then proceed to the chemical examination."

Some years ago it was customary, more than now, to examine with the microscope water intended for the

use of towns. Attempting at one time to join the chemical and microscopic together, as they were too much in separate hands, I came to certain general conclusions:—That no ordinary pure water produced much vegetable or animal life, and that microscopists were mistaken in allowing people to suppose that every drop of water was inhabited; that nevertheless water, generally considered very pure for drinking, might contain some forms not possessed with distinct locomotion; that whenever distinct locomotion began, especially among soft-bodied forms, the water was more than suspicious; that forms increased with the quantity of organic matter containing nitrogen, until the amount was so great as to cause gases of decomposition which eventually stifled life. How far this stifling of life proceeds I do not attempt to say. I suppose it will not apply to the mucedines, which cause putrefaction to commence.

If the water was impregnated with sewage water (as the Thames at London, for example), bad cases excepted, the amount of vegetation which spread over the sides of a bottle filled with it and set in the sun, was so great as to give the appearance of one solid mass. If the water were taken from the river above Reading, the amount of vegetable matter was seen as a delicate green colouring at the bottom of the vessel; and if it were taken up at the source, no greenness whatever appeared, but, after long standing, minute crystals of limestone. If the water contained sewage, the phosphates and magnesia were generally found collected in some form of the *Navicula*, frequently in large groups of the *Navicula fulva*, and with it also was found phosphoric acid and magnesia. It was sufficient to note the condition of the water with relation to these deposits to ascertain at what part of the Thames the specimen was taken; and without the examination of these deposits, I do not consider that it would have been possible to obtain a distinct idea of the nature of the organic matter present. It is, however, needful that we know the general character of the water; had we a specimen from another situation and found no deposit whatever, it would have been very unfair or very unwise to conclude that it was similar in quality to that from the source of the Thames. It might have been saturated with nitrates, and even a large amount of organic matter not capable of taking the forms alluded to. Perhaps, however, nitrates prevent decay in water as in meat. As the germs of the lower forms of life may pass by us unobserved, it is necessary that we should give them time for development, in order that they may become sufficiently prominent to attract our attention. For this reason I consider it an imperfect examination of water when this is not attended to, in cases at least where we have not the slightest idea of the nature of the water. We find water with less than two grains of organic matter per gallon giving rise to forms by no means agreeable to look at in our food, and water with several grains of organic matter giving rise to no such forms.

It is true that we cannot tell which of these living forms are most dangerous; we cannot tell which of them, if any of them, produce either cholera or any other disease; but we can say that water which contains them may contain the elements of disease, whilst water which does not contain them or matter to make them is innocent. So far as this we are obliged to go at present. It was for these reasons that I have not recommended the method of estimating the total nitrogen in water. I was inclined to believe that the danger arising from water could not be measured by the amount of organic matter, or even by the amount of nitrogen in the organic matter.

Still it is of advantage to estimate the nitrogen of the organic matter, in order to compare the state of one source of water from day to day, as, for example, Dr. Frankland does so frequently in the case of the Thames. It is not, however, the organic matter only that gives out nitrogen; that is given out by ammonia and nitric acid; and these must also be estimated when seeking albumenoids. And this course is adopted by Profs. Frankland and Wanklyn.

We may now inquire how far all these bodies together will give us the amount of the organic matter falling into the water.

When azotised compounds decompose and form ammonia, how long is this ammonia retained in the water? On examining a very putrid stream, I estimated the amount of ammonia at the most putrid portion, where carburetted hydrogen was passing off in great volumes, and where a cubic foot could be obtained in a very few minutes by stirring.

In the sewage stream of which I have spoken, the amount of ammonia was from 0·5 to 0·7 grain per gallon. After going 14 miles, the amount was only 0·07, and, after 20 miles, none at all was found. To say none at all, is to go far, but it was not found by the mode adopted for the others.

The mud of the same stream was in a state of putrefaction, and contained, per cent—

Ammonia	0·797
" a mile lower	0·420
" at second mile	0·171

The ammonia rapidly disappeared, and the mud itself diminished very greatly in amount.

I estimated that one grain of ammonia evaporated, in some seasons, from every square foot per hour.

In taking sewage water to the land, I think it very important that the movement should be as rapid as possible.

The water, in its passage of 20 miles, has lost its valuable ammonia, and that within two or three days. This is a sufficient proof that we must not trust to the ammonia as an indication of the amount of the organic matter which has been present, as it is as rapidly removed as the organic matter is decomposed; that is to say, the length of time necessary for complete putrefaction is, under favorable circumstances, no greater than the time afterwards required for the removal of its products. In enquiries on putrefaction, I have found the temperature 12·2° C. a marked one. Putrefaction may be said to begin actively at that point, and the results here given would, probably, be very different below that. In this water there was no moving life to be observed; but the estimation of the organic matter would have shown no difference, whether vitality had been present, and the substance had been capable of entering into active and unwholesome forms, or had been ready to break up into instantaneous putrefaction, or had been preserved, like a mummy, in carbolic acid for a thousand years.

From this observation regarding the ammonia, we are clearly led to beware, in our schemes of irrigation by sewage water, that the land shall be overflowed before the ammonia is thoroughly formed, or else, if the ammonia is formed, that it shall not be subjected to loss by long exposure to evaporation.

We see, also, that nature provides here for the com-

plete obliteration of organic matter. It ceases altogether to be found in the water. It may be traced, either as such, or as ammonia and carbonic acid, long after the bubbles of carburetted hydrogen have ceased to appear, until, at last, it dwindles down to an amount which is rather difficult to remove from water, and which, so far as we know, may be utterly disregarded.

In the passage of organic matter, we may observe, from figures soon to be quoted, that the volatile and organic matter diminished from 9·33 grains per gallon down to 5·04, even when there was an increase of fixed matter, and that the decomposing matter in solution diminished still more rapidly, in the ratio of 283 to 17. The use of the word decomposing matter is not quite correct; it means the substances in solution, arising from decomposing matter and absorbing oxygen at once. It must be observed that the time required was two or three days; and I may add that I could not have drunk the water at last, but there was great foulness to begin with. Still, it shows great removal of impurity.

The organic matter having left the water, we may next inquire whether any trace of its existence remains behind. That trace we do find in the increased amount of alkalies, sulphates, and chlorides.

The alkalies and alkaline salts, but especially common salt, are prominent. The whole of the common salt which has been used as food, without the slightest loss, is found in water, when vegetation has not removed it. The sulphur has become partly oxidised, leaving sulphates, whilst some may have left in company with hydrogen. Phosphates have been increased for a time; but they rapidly fall, taking lime and some magnesia with them; and, on the whole, the great change to be observed in the water is connected chiefly with the alkaline salts. The most stable and most constant of these, without loss, is common salt.

On this subject, I may quote what has been said elsewhere regarding the chlorides as an indication of the presence of animal matter, proper regard being had to the absence of other sources, which, in this country, are chiefly connected with artificial circumstances. "The absence of the chlorides, especially, may be considered as the certain absence of sewage matter, and their amount to be estimated as an indication of the comparative amount of sewage matter from day to day, in cases where sewage only pollutes the river." I conclude from these data that the organic matter and the nitrogen in it are equally incapable of giving us a sufficient history of the water. We may draw another conclusion, that nature has provided a mode in certain conditions for its perfect removal.

It is worth while to ask whether this purification by putrefaction is not the most complete method; it seems to destroy that which we consider to be germs, which germs may be a beginning of any disease of the most terrible form. Having read most that I can find on this subject, I have been led to think that the water, before and during putrefaction, may contain the diseases that have been washed from cities, but that the air above, containing the gases and vapours, does not contain the germs of these diseases, although, of itself, it is extremely loathsome and decidedly unwholesome. It is rapidly purified by the atmosphere. However, I reason from the facts obtained by others, since disease is not my study. After complete putrefaction and clearing, the water seems to be used with impunity. Our rivers, however, seem too small to purify large quantities in their course, as even in warm weather, the time must be measured by days if the specimen given is a fair one. I do not pretend to say how much may be allowed to go into a river of a given size without fear, but this may be found, as, after all, every river has some sewage from animals, and, in this country, even from man also.

If the water were allowed to clear itself by standing, producing whatever amount of organic life could be developed from it, the germs might be increased in number, instead of being diminished. It is proper to observe that the liquids must be included. The solids contain little chlorine. The water above might remain very clear, but might be, nevertheless, very dangerous. In such a condition, water seems to be best purified by filtration through the soil, which simply means extremely slow and careful filtration, accompanied with partial oxidation; in that case, the water coming from under the soil would be fit again for use, although it would contain, and does contain, the alkaline salts alluded to.

Waters from rich lands, unless from very deep drains, always contain more organic matter than water from hills, and more albumen, or matter so conditioned that it is capable of assuming a great variety of living forms with and without locomotion. Water from the hills of Scotland and Wales, Cumberland, and many parts of North England, gives rise to no variety of living forms; and, in many of them, there is scarcely anything to be remarked in the deposit, unless opportunity is given for collecting it from a large quantity of water, and concentrating. On studying this subject many years ago, I found that, in some of those cases where the water was peaty, there was also to be found a large amount of ammonia. The words I used were these:—"In a peat bog which is not well drained, and is, therefore, wet and cold, the acids of the peat do not become dissolved so as to form a very deeply coloured solution, but they form a solution of a pale yellow. But in grounds which are warmer, or, what is better, well drained, the amount of soluble matter is very great. The colour of such water is not to be confounded with the water which heavy showers bring down, filled with mud and bits of peat; it is often perfectly clear and bright, but brown like coffee. The acids in solution at such times are kept so by the presence of ammonia. Ammonia dissolves them in large quantities, and along with them also the salts which they form with lime, magnesia, soda, phosphates, &c.

"Plants begin to grow in warm weather; at this time ammonia is formed. It is at this time the organic matter decays, and, in its approach to inorganic matter, passes through this stage of ammonia.

"The peat mould Mulder has shown, but he has not mentioned this excess of ammonia."

I supposed at the time, as it appears, that the ammonia produced by the decomposition of vegetable substances was used for the solution of the ammoniacal humates of Mulder. The paper read was only a short note intended to call attention to an important and curious point—the amount of ammonia on those bare hills. I have had the subject before me frequently since that period, namely, 1847, but have never given it all the time required for its elucidation. Lately, Professor Wanklyn and Messrs. Miles Smith and Chapman have examined the hill-waters, and have rather alarmed the public by informing them that they contain more albumenoid matter than waters coming from rich plains. The process they adopted has, no doubt, shown two conditions of the nitrogen; and it is pos-

sible that one may be albumen; but it seems perfectly clear that it is not putrescible albumen. I had long ago found the nitrogen; it still remains to find out all the conditions of its existence. If waters containing nitrogen from the hills are allowed to stand, they neither show their nitrogen by the production of living forms in proportion to the amount of that element, nor by putrefaction; any fear, therefore, of such results may be entirely put out of our minds. The living forms, which are the most dangerous, are fewer than from pretty deeply filtered water of the plains; and putrefaction cannot exist when the matter to putrefy is so minute: when the solutions are extremely weak, oxidation overpowers it. Such, at least, is my experience.

A reason for believing that nitrogen exists as albumen is the large amount of fish which the water supports. But protein exists in many conditions. The learned originator of the word had the idea of the prophetical and changeable Proteus in his view, as well as the rank of the substance as first in importance, because it forms man. I think, however, the probability is that the earth acids keep it from change, united to the generally low temperature on the hills. This latter, however, does not seem needful. These soils saturated with peaty water are not to be compared to flat, wet, and ague-bringing grass and other lands. I find the process of Professor Wanklyn still more valuable since I wrote the above, although I adhere to the reasoning that, although he may be right in believing albumenoids to be present, the water is not, to that extent, hurtful. The same applies to the reasoning, as I understand it, of Dr. Frankland. But we need not quarrel; it is enough if we each try to elucidate the subject.

Let us now consider what does take place during putrefaction. In all cases known to me, the first thing that occurs is the diminution of oxygen in the air absorbed by the water, and, to a more or less extent, the production of sulphuretted hydrogen, which, however, may exist in the water to a very small extent at a time, being rapidly converted into combined sulphuric acid when oxygen can be found for the purpose.

In Loch-Katrine water, the oxygen found in the absorbed air, by Dr. Penny, was equal to 31·69 per cent; that of the Manchester water is equal to 27 per cent. In the Liverpool water, at the bottom of the reservoir, the amount fell to 12 per cent, being equal on the surface to the Manchester. In the first case, as well as in the second and similar cases, the amount of oxygen is too great to allow of putrefaction; and in the third case it was very clear that the oxidation was a process of decolourisation, at least in part, whatever else may have occurred. This decolourisation is caused by the oxidation of the *humus* and its removal as carbonic or other acid.

The gases of pure water contain nearly 34 per cent of oxygen.

Dalton found cistern-water almost entirely deprived of its oxygen; and I have found every percentage of oxygen from 34 downwards.

I go further into this point in my chapters on water, which I hope to bring out soon. Meantime I may say that the examination for oxygen is a very important one.

Another important feature in putrefaction is the occurrence of carburetted hydrogen. The carbonaceous or organic compound, having lost the ties that bound it together, is broken up into fragments. The carbon, when it can find oxygen, goes off in its company, but otherwise it leaves with hydrogen; separate, however, it must, and that with considerable violence. When there is a great amount of oxygen these decompositions of organic matter do not take place; and even if the Loch-Katrine and other water were largely supplied with organic matter, putrefaction would be entirely absent, as it now is, as long as the high amount of oxygen was kept up in continual presence.

That organic matter does exist in peaty water to a larger extent than in streams not peaty, but still offensive, may be taken for granted. A very brown water contains about four grains per gallon. It is extremely dark, indeed, if there are six grains; but, without peat, putrefaction, or, what is still worse, the development of mischievous germs, may occur, whilst in the other they seem stifled. How far this disinfecting and preserving quality of peaty matter will act in weak solutions I cannot tell; but in its greatest strength (that is, surrounded by the matter of the peat itself), preservation may exist for an indefinite time; and the non-occurrence of putrefaction in weaker solutions may be considered sufficient to show that there is abundant antiseptic power for the amount of matter to be preserved in these waters.

But the question still arises, what is this organic matter containing nitrogen? If it is albumen it is disinfected, if the peat is great in amount; and it is incapable of putrefaction, if the oxygen is great.

We are not perfectly sure that these ammoniacal humates of Mulder's actually exist in the form he mentions. It may be that the nitrogen is otherwise combined, giving another mode of explaining the conditions of the water. If they are combined, as Mulder believes, we have only to allow oxygen to enter the brown water and be absorbed, a process which readily occurs; the *humus* is bleached, and the ammonia is free to combine with carbonic acid, and readily to dissolve a fresh portion of the same salts of which it formed a part. If the nitrogen be otherwise combined, whether as albumen or any similar substance, the oxygen will still play a corresponding part.

By this view of the subject, the brown waters would be giving off carbonic acid, freeing and losing some carbonate of ammonia. When oxidation takes place, a certain acidity is found, coupled with a little bitterness, a quality possessed by great portions of the waters of the hills. This, I believe, occurs in those waters which have not been purified by descending deep into the earth (where thorough oxidation and sweetening take place), but which have passed only over the surface, and been partially oxidised. The complete oxidation produces carbonic acid; the restricted oxidation an acid that is not volatile, and is extremely bitter. I have prepared so little of this, that I am unable to give a good account of it. It was formed from extremely brown water, chiefly from the river Avon, in Lanarkshire. By its formation, the water became very bright; when boiled down, the acid became stronger to ordinary tests, and its bitterness became more intense.

I may remark, by the way, that in all the bottles in which this occurred there was a deposit of very fine flakes of silica, leading me to think that, by our usual modes of estimating that substance, we were apt to make the amount too small. I believe this acid to be the origin of that bitterness which I have so often observed on the hills; and even in the very brilliant water from the hills, the two processes have been going on at the same time—the formation of carbonic acid and the formation of the non-volatile acid.

[English Edition, Vol. XIX., No. 497, pages 281, 282; No. 499, page 304.]

Apparently there are times, perhaps flood-times, when the water does not become oxidised so much as usual; and then we find the bitterness as a result in a greater degree. Although I had observed this for many years, I had not known that the effects might be hurtful to those who drank the waters. I met this year, accidentally, at Oban, Professor Frankland, who told me of some gentlemen who had been very much inconvenienced and who actually took supplies of spring water with them to Inverness, at which place they had found the river to cause diarrhœa. I am not aware that this disease is more frequent at Inverness than elsewhere; but the water, or at least the substance in it, to which I allude, seems to be unwholesome to those who have not been accustomed to use it.

Chloride of calcium is observable in water from the clay slates of the west of Scotland, at least in some places. It is found also in Loch-Katrine water, although I have not seen it mentioned.

For some years I was inclined to believe that the bitter taste was owing to these salts, until I found it increased by oxidation. I am not prepared, however, to say that they are incapable of modifying the taste, although they exist in quantities very minute.

Taking this view of the case, water collected in the mountains is very different from that which has run down into the plains. The age of the water also is a matter of importance, and if kept long in deep reservoirs or in shallow reservoirs.

If in shallow reservoirs, the water may be uniform throughout; if in deep reservoirs, the oxygen may never be able to permeate to the bottom. At a depth of twenty feet I have found more than twice as much organic matter than was to be found on the surface, whilst the lower specimen was of a much deeper brown. This was in the Rivington reservoirs, as already said.

Water that comes down very rapidly may never be able, in a practical period, to have the organic matter thoroughly oxidised. Water which purls down rather slowly, falling, nevertheless, over many rocks, is always clearer, although the reason partly of this is, that such water is not surface only, but has drained through the soil.

Peat itself, if distilled with fixed alkalies, gives out ammonia. I suppose there is no doubt that some of this arises from the decay of vegetable albumen, some of which may be retained in the peat; but its mode of decomposition is still a problem; it seems to take place chiefly by oxidation, not putrefaction. I was inclined to think that a notable amount of the ammonia might be taken by the acid waters direct from the atmosphere.

But the smoke of peat, or rather the oily matter deposited by the smoke, contains nitrogen compounds, very probably the bases obtained by the decomposition of that vegetable albumen, which will not enter into fermentation, or expand itself into the lower and dreaded organised forms, although compelled to yield to the action of fire. This shows that all the nitrogen does not exist as ammonia. Although Mulder is highly to be honoured for the work performed in endeavouring to elucidate the subject, and especially the question relating to *humus*, it is not easy to agree with him. If, however, any one would begin where he has left uncertainty some reward would be found.

I give a few quotations from Mulder's "Physiological Chemistry," first German edition:—

"I repeat that the ammonia in the soil, as in the natural saltpetre-grottos of Ceylon, is formed from the atmospheric air, the oxygen of which, instead of forming nitric acid, changes the organic substances into ulmic acid, then into humic acid, geic acid, apocrenic acid, and into crenic acid.

P. 158. "This formation of ammonia from the constituents of the air and water is of the highest importance for the growth and success of the plant. It is the cause which converts the insoluble organic constituents of the soil into soluble substances, and thus presents them to plants as organic food, even when no ammoniacal manures are added besides to convert the five mentioned acids into soluble salts of ammonia."

P. 166. "Ulmic, humic, and geic acids, however formed, possess the power of absorbing ammonia and water to the extent of several per cent. The quantity given out (at 140°C.) is between 8 and 16 per cent. It requires 195° to free them from water."

P. 167. "The power of ulmic, humic, and geic acids to condense ammonia is so strong, that the acid made by acting on sugar with hydrochloric acid almost always contains ammonia if air is not kept away."

P. 169. "These acids combine so intimately with ammonia, that they have the character of an organic compound of four elements; by treatment with potash at a higher temperature they lose the ammonia completely."

In the "Handwörterbuch der Chemie," under "Humus," it is said that by constant digestion with hydrochloric acid, ammonia was not removed. It is also added that, boiled with an alkali, the ammonia is not removed.

This accounts for the opinion held by Berzelius and others, that nitrogen existed in these earth acids; and certainly it is not clearly shown that they are only ammoniacal salts.

Berzelius gives Hermann's old analysis of crenic acid as containing nitrogen; and until we can finally settle the composition of these substances, we may be allowed to doubt. Whatever the compound be which contains nitrogen, its disinclination to putrefy must lead us to believe that even the organic nitrogen is not a measure of the dangerous quality of water, whether that nitrogen exist in a non-putrescent condition or association of the albumen, or in a substance removed a step from albumen and passing downwards to a condition more allied to the idea of an inorganic body. My own belief is that part of the ammonia is in combination with earth acids, and part of that which we find is obtained by destroying an albuminous substance rendered non-putrescible by its surroundings.

I have given my reasons for believing that neither the nitrogen of ammonia nor the other nitrogen found in peaty water can be taken as the indication of the amount of putrescible matter. At present, I believe, we have no idea of the actual relation in which it stands to health. It will be interesting to know now if the nitrogen of the nitrates and nitrites is at all similar. These salts are not formed when putrefaction is going on rapidly. The reason is very simple: the water is then deprived of its oxygen. We do not know all the conditions of the formation of these salts; but one is essential, that oxygen shall be present.

In the Thames water, at least two miles below and above Hungerford, there was nitric acid in considerable abundance in 1848. It is mentioned, in evidence given in a parliamentary inquiry twenty years before that, that red fumes rose on heating the deposit. I quote from memory.

In 1848 this was certainly the case. In later analyses, by Dr. Hofmann, the nitric acid was not

mentioned. I considered this at the time a mistake; and I examined the water again, finding, however, extremely little nitric acid, and, I believe, in some cases none.

Having examined other putrid streams, and found no nitric acid, I conclude that it had disappeared from the Thames also when it became more impure than previously.

During the time that river was so offensive near the Houses of Parliament, the organic matter must have wholly, or nearly deprived of its oxygen the air in solution. Running streams, however, do not, so far as I know, contain much nitric acid; that substance is formed in greatest quantity by the action of porous bodies. The oxidation is assisted by the pressure to which the gas is exposed by being brought in contact with a great amount of surface, as well as of numerous surfaces contributing to the result. For these reason snitrates are found best in soils through which azotised matter in solution is slowly passed.

I had occasion to make experiments on this point, and showed, in a paper to British Association, in 1848, that a filter might be made to form nitrates from putrid matter.

An interesting question arises—Does the nitric acid indicate the amount of organic matter which was previously in solution?

If nitrates are put on land, they are decomposed by vegetation, and the nitrogen is retained. These salts act both as food and air to plants. The water which flows from drained land may contain nitrates, but they are not a measure of the amount put on the land; and if they result from the organic matter there, they are still not in proportion to its amount, as, even after they are formed from vegetation, they may be decomposed by it.

Nitrogen, therefore, may be removed from water either as ammonia, or organic matter, or nitric acid, every trace of it finally disappearing. Those nitrates, however, which do remain indicate that at least an equivalent of albuminous matter or sewage matter did exist.

Another interesting question occurs—Is the nitric acid removed without vegetation? I believe that it is so.

In water from drained fields vegetation is generally found, though frequently in very small quantities. In the soil around drains it is found in considerable quantities; but after putrefaction has occurred in the Medlock, at Manchester, I have not found it. The oxygen seems to be removed as the oxygen of the air is, probably leaving nitrogen to pass off as gas.

As the nitric acid indicates an equivalent of albumen, I have put it down as telling us of the previous presence of organic matter; in other words, of old organic matter. The word "old" has no relation to time, except so far as to mean older than that from which the nitrites are formed, and the original organic matter. The nitrites, not being fully oxidised, are supposed to be in the process of becoming nitrates. They have been taken, therefore, as indicating recent organic matter,—the word "recent" meaning only that they stand between the organic matter and the nitrates. I do not know that nitrates are converted into nitrites in water. Still it may be found to be so.

It may be asked,—If the nitrates are not a proof of albuminous matter, whence do they come? If it is said from the air, as Mulder would bring them, we need a proof; if from ancient remains, we need a proof; but we need no proof that they can come from albuminous substances. I believe they come from both animal and vegetable matter, so that decomposing roots and plants will send out some; but animal matter is the richest source. We have animal sewage and vegetable sewage. The latter is capable, as is well known, of doing much evil—perhaps not so much as the former, although this is uncertain. It does not seem proved that grass itself will not give nitrates. Yeast produces them. If vegetable and animal albumen are equally bad, we need not care as to the distinction of source; if nearly equal, we may care but little.

In looking for organic matter, I think it quite unsafe to trust either to chemistry or the microscope, without giving time for the development of all possible germs; but this is a point which demands a good deal of inquiry. Microscopists have given us details of appearances; but these have not been sufficiently classed; and the conclusions drawn have, therefore, not been valuable to the desired extent. To trust to the microscope without time for development, is to believe that the germs of disease can be seen. The use of allowing water to stand is not that the germs of disease may be seen, as we do not know them if we see them, but to see if the matter is active. The value of this must be tested.

The loss of the oxygen with peaty matter and no vegetation indicates, as already said, the formation of carbonic or bitter acid. The loss of oxygen with the evolution of sulphuretted hydrogen indicates putrefaction; but there are two conditions which externally resemble each other very much, namely, the growth of vegetable matter with diminished oxygen, and the growth of vegetable matter with excess of oxygen. Water in the first of these conditions, too, may contain, as I imagine, the most dangerous ingredients: germs of all diseases may exist in such waters; we do not know to what extent; and, as we are very ignorant on the subject, it is well to be alarmed at the conditions, until we have examined them and made distinctions.

We do not know very much about the second of the two; and if I think it less dangerous, it is perhaps more from a prejudice in favour of the abundance of vital air, and of those hill-waters which do not contain bitter peat than from any accurate knowledge which has been attained.

Weighing the Organic Matter.

If nothing apparently organic is seen, or if there be no time to allow it to germinate, we may try the following method: About half a gallon of water is boiled down in a platinum vessel; or if there are no soluble carbonates it may be boiled in porcelain and transferred with care, when only a few ounces are left, to a platinum or even to a small porcelain capsule. The residue is dried and weighed. It is then burnt so as to oxidise the carbon, and weighed again; the difference gives the organic and volatile matter of the residue. 212° F., or 100° C., is not sufficient to remove all water; but as it is a temperature so easily obtained, it is convenient to consider it enough, especially as we cannot obtain the organic matter by weighing with absolute exactness. We may obtain an excess of water by the use of 212°, on one side; but, again, organic matter begins to be given off from some residues even at that temperature; Professor Miller and others advise about 300° F. It is, at any rate, well to state the temperature in the account of the analysis. Both tem-

peratures appear to me wrong, and so is every other I can think of. The results, however, of this method are very useful.

The burning must not be effected at a very high heat, or several salts will be decompo ed or evaporated; but at best some will suffer; and the use of a little carbonic acid and water, or carbonate of ammonia, to restore the lost amount, is advisable. A little distilled water and a few expirations into it through a glass tube will be sufficient for most cases; of course after this the ash must be heated again.

Professor Miller advises the addition of 0·3 gramme of carbonate of soda to a litre of water, or 20 to 25 grains to a gallon, making allowances in the weighing.

It is needless to remark that I consider Frankland's mode of obtaining carbon and nitrogen far superior to any weighing, when hands sufficiently delicate are found. By using larger quantities, there seems no reason for supposing that the process cannot be undertaken by men who cannot advance beyond average refinement of touch. Since this paper was read, about a year and a half ago, the Wanklyn process for nitrogen has been gaining favour in my laboratory, as the results obtained have been very constant.

(To be continued.)

ON THE PROXIMATE ANALYSIS OF COALS.*

BY PROF. GUSTAVUS HINRICHS,
CHEMIST OF THE GEOLOGICAL SURVEY OF IOWA.

Determination of the Moisture.

A FLAT-BOTTOMED iron pan, of 20 centimetres in diameter, was filled evenly to the depth of 1½ centimetres with sand, and the latter was covered with a copper plate, on which the watch glass containing the coal was placed. A thermometer (scale to 370° C.) was, by means of a rubber stopper, inserted in an iron arm of the tripod supporting the iron pan, and held with its bulb about half a centimetre above the copper plate. By means of a Bunsen burner it was found very easy to keep the thermometer perfectly constant at 115° C. This apparatus I consider a good substitute for Fresenius's iron plate.

The coal to be dried was finely pulverised, direct experiments having convinced me that the application of fragments was not only very much slower, but also erroneous, on account of the peculiar property of bituminous coal treated of below.

In order to show the accuracy of this method, I transcribe the following examples from my journals:—

No. of Coal.	Weight of Portion.	Time.	Moisture. Per cent.	Moisture. Deviation from Mean.	Mean.
390 e	0·961	1 hour	4·888	—0·004	4·892
" f	0·919	1 "	4·896	+0·004	"
" e	0·961	2½ "	4·160	+0·010	4·150
" f	0·919	2½ "	4·140	—0·010	"
339 e	1·452	1 "	8·260	+0·070	8·190
" f	0·975	1 "	8·120	—0·070	"
" e	1·452	3 "	7·160	+0·170	"
" f	0·975	3 "	6·830	—0·160	"
338 e	1·415	1 "	3·852	—0·029	3·881
" f	0·805	1 "	3·911	+0·030	"
" e	1·415	2½ "	3·287	+0·123	3·164
" f	0·805	2½ "	3·042	—0·122	"
" e	1·415	5½ "	2·722	+0·088	2·634
" f	0·805	5½ "	2·546	—0·088	"

* Communicated by the author. For a previous paper on this subject see, also, vol. xviii., p. 53. (*Am. Repr., Sept.* 1868, *p.* 143.)

These results—a few taken from among a great number of determinations—show that the loss (called moisture) decreases regularly after the first hour of drying, that is to say, while the coal loses in weight during the first hour, it steadily gains in weight thereafter. It appears, furthermore, that the accuracy of a determination, expressed in the smallness of the deviations from the mean, is greatest at the end of the first hour of drying, least after about three hours of drying, and thereafter increases again, as expressed in the diminution of the deviations after 5½ hours' drying in coal No. 338.

On account of these peculiar properties of our bituminous coal, I put down as *moisture* the loss in weight of the finely-pulverised coal after one hour's drying at a temperature between 105° and 110° C.

On the Slow Oxidation of Coal.

This increase in weight after the first hour's drying I have found in all Iowa investigated as yet. I have also found it to occur in a sample of coal (Steinkohle) from Benthen, Silesia, which showed a loss of 3·62 per cent at the close of 1 hour, and in 4 further hours' drying gained again 0·42 per cent. It was not noticed in brown coal from Bilin, Bohemia, nor in anthracite from Pennsylvania. I am, therefore, inclined to believe this to be a property peculiar to pit-coal (steinkohle).

On page 401 of vol. I, p. 1, of the "Iowa Geology," Professor Whitney remarks: "A remarkable fact in connection with the determination of the water present in the specimens of coal has been noticed. In numerous instances, after the sample, in the form of a coarse powder, had been dried for several hours in the air bath, at a temperature a little above that of boiling water, during which time it had gradually lost weight until all the water seemed to have been expelled, on continuing the operation for some time longer, a slight increase of weight would become perceptible, and the coal would continue to grow heavier, until a gain of several tenths of a per cent of the original weight had been made. This appears to be owing to the slow oxidation of the sulphur which all these coals contain in a finely divided state, disseminated in invisible particles through the mass, and, perhaps, partly in combination with iron."

It is evident that Professor Whitney failed to discover this property as a general one, because he had the coal in coarse fragments. The want of correspondence in the results of determinations of moisture in the same sample, dried at the same time, but of different weights, made me apply the coal in the form of powder. Thereby the turning point was reduced from "several hours" to less than one hour, the "numerous instances" extended to all samples investigated, the "slight increase of several tenths of 1 per cent" became often 2 and even 4 per cent! Instead numerous exceptions we now discovered a general law.

We have failed, as yet, to notice any "sulphur" disseminated through the Iowa coal; what popularly is called sulphur is pyrites. Professor Whitney has given no proof of the excistence of real "sulphur" in the coal. It is, therefore, unsatisfactory to ascribe this property of the bituminous coals to such "sulphur."

Pyrites might well be the cause of this phenomenon; the red ashes obtained in many cases (in Van Buren county, Iowa, invariably from the upper part of the coal bank) may well be ascribed to pyrites disseminated through the coal in invisible particles. Two FeS_2 will give Fe_2O_3,+$4SO_3$ by exactly doubling th ir weight.

In order to decide the question, I select the following results from my analyses:—

Influence of Time of Drying.

Top coal.....	No. of samples,	4	3	2
	Time of drying,	2	3	4—5 hours.
	Mean gain, p. c.,	0·45	0·71	0·96
Bottom coal.....	No. of samples,	3	5	2
	Time of drying,	2	3	4 hours.
	Gain, per cent,	0·49	0·50	0·96
Mean of above...	No. of samples,	7	8	4
	Time of drying	2	3	4—5 hours.
	Gain, per cent,	0·46	0·63	0 96
	Gain, per hour,	0·23	0·21	0·24

or, on the whole, for 19 samples of coal, very nearly proportional to the time, this being not more than four hours. It also appears that no essential difference is apparent in regard to the position of the sample in the coal bank.

By this means we may compare the following determinations, referring to two, three, or four hours drying. We find:—

Coal. Place—No.	Time, hours.	Increase, Total.	Per ct. per hr.	Difference.	Colour of Ashes.
top 390	2	0·75	0·38		pale brown.
				0·22	
bottom 384	2	0·35	0·16		white
bottom 395	4	0·80	0·20		red and white.
				0·04	
top 375	4	0·64	0·16		white
top 346	3	0·68	0·23		reddish brown.
				0·08	
bottom 371	3	0·45	0·15		white.
top 336	3	0·76	0·25		gray.
				0·06	
bottom 334	3	0·58	0·19		gray.
top 333	3	1·17	0·39		pink.
				0·09	
bottom 340	3	0·91	0·30		light gray
middle 357	3	0·55	0·18		white
				0·03	
top 370	3	0·46	0·15		reddish.

Except in the coal from the last mine, we notice that the more ferruginous ash does correspond to a slightly greater increase in weight; but we notice also that this difference is but very small as compared to the total amount of increase, being only 1-5 to 1-3 of the whole. Arranging these coals in the order of this hourly increase, we find the colour of the ashes not at all forming a regular series from white to red, as it ought to be, if this increase was mainly depending upon the oxidation of the pyrites. Besides, the mean of the four white ash coals is 0·16 per cent hourly increase. while the mean of the four coals showing the greatest increase is only 0·33 per cent, or double the former.

Coal.	Increase, per cent.	Ash.
333	0·39	pink.
390	0·38	pale brown.
340	0·30	light gray.
336	0·25	gray.
346	0·23	reddish brown.
395	0 20	red and white.
334	0·19	gray.
357	0·18	white.
375	0·16	white
384	0·16	white.
371	0·15	white.
370	0·15	reddish.

The greater increase of the pyritiferous coals is accounted for by the oxidation of the pyrites they contain; the comparatively great increase of coals giving a pure white ash seems to force the conclusion upon us that the bitumen of the coal itself oxidises, and that to this oxidation the main increase of all these bituminous coals must be ascribed. Remembering, now, our result regarding the deportment of bituminous coal from Silesia, anthracite from Pennsylvania, brown coal from Bohemia (all of which gave ashes very nearly of same shade, and all of which had been in my air-heated laboratory for two years), it seems not unlikely that this is another characteristic chemical difference between bituminous coals and other fossil coals.

In conclusion, I will give only two additional determinations, showing a very considerable increase in weight, and also that the process of oxidation is completed in about six hours for two-thirds grammes of coal. For No. 329, containing 8·30 per cent of grey ashes, gained in 5½ hours 2·05 per cent of its original weight. Coal No. 348, with 6 per cent red ashes, weighed 0·693.

		Change. Weight.	Per cent.	Total loss. Per cent.
After ⅔	hours, 0·630	loss 0·063—	9 091	9·091
" 2	" 0·625	" 0·005—	0·722	9 813
" 5½	" 0 656	gain 0·031—	4·474	5·339
" 8¾	" 0·656	" 0·000		5·330

Determination of the Ashes.

The best way to determine the ashes in coal I found to be the coking of the finely pulverized coal in a small platinum dish (weighing about 8 grammes) with subsequent incineration of this coke in the same vessel. The incineration takes place with great ease and rapidity, and the results are perfectly satisfactory. Thus 3·022 grammes of coal No. 333 gave 2·25 per cent, and 5·263 grammes of the same coal gave 2·58 per cent, deviating from the mean 2·46 by +0·11.

In regard to the ashes of our Iowa coals, I have found that they are very much more uniform in their distribution throughout the coal fields than usually thought possible. In Van Buren county I find the "bottom" coal giving a white or light-coloured ash, the "top" coal of the same bank a red-coloured ash, a fact which I intend to make use of in a subsequent paper on the origin of our coal. I also find the amount of ashes to increase quite evenly (in this county) toward the margin of the coal field from about 2 to 7 per 100 combustible.

Determination of Specific Gravity.

Coarse fragments, freed by means of a sieve from all small particles, and averaging 1-10th cubic centimetres in volume, were introduced into a fifty-gramme flask provided with thermometer stopper. The contents for this flask for temperatures varying from 50° to 80° F. had been carefully determined.

The given specific gravity corresponds to the coal perfectly soaked, so that all its pores were filled with water. That required, on the average, 12 hours, permitting two determinations per day, one in the morning, another in the evening.

That this is not at all trifling may be seen from the following example:—2·760 grms. coal (No. 350) gave the specific gravity 1·309 at 64° F., immediately after filling the flask with water; after about 12 hours' soaking, the specific gravity had increased to 1·328, for the same temperature. According to this latter determination, a cubic foot of this coal would weigh 82·76 lbs.; according to the former, only 81·58, or 1·18 lbs. less. This shows a considerable degree of porosity of the

coal, and indicates the absurdity of giving the weight in pounds of a cubic foot of coal with four decimals, although no statement in regard to temperature or time of weighing is made! Such accuracy we meet with in some of the official reports!

Calculation of Results.

Referring to my previous paper (Chemical News, vol. xviii., p. 53. *Am. Repr., Sept.*, '68, *page* 143), it may be sufficient here to state that, besides the percentage composition of the coal, it is proper to reduce the composition to the combustible=100, in order to obtain a proper comparative estimate of the character of the fuel itself (in regard to the proportion of bitumen and carbon), and of the amount and quality of the impurities (ashes and moisture). It has also been shown in the paper referred to, that, for considerable areas of the coal field, the sum of the constituents on the scale of combustible=100 is the proper caloric equivalent, and that the percentage of the combustible in the fuel gives a proper estimate of its value.

According to this method, a considerable number of analyses of Iowa coals have already been made, and a greater number are yet to be executed. It is believed that the results will be strictly comparable for the entire coal-field of Iowa, and that the conclusions, both practical and theoretical, will deserve some confidence.

RESEARCHES ON GASEOUS SPECTRA

IN RELATION TO THE PHYSICAL CONSTITUTION OF THE SUN, STARS, AND NEBULÆ.*

BY E. FRANKLAND, F.R.S., AND J. N. LOCKYER.

I. The Fraunhofer line in the solar spectrum, named *h* by Angström, which is due to the absorption of hydrogen, is not visible in the tubes we employ with low battery and Leyden-jar power; it may be looked upon, therefore, as an indication of relatively high temperature. As the line in question has been reversed by one of us in the spectrum of the chromosphere, it follows that the chromosphere, when cool enough to absorb, is still of a relatively high temperature.

II. Under certain conditions of temperature and pressure, the spectrum of hydrogen is reduced in our instrument to one line in the green, corresponding to F in the solar spectrum.

III. The spectrum of nitrogen is similarly reducible to one bright line in the green, with traces of other more refrangible faint lines.

IV. From a mixture of the two gases we have obtained a combination of the spectra in question, the relative brilliancy of the two bright green lines varying with the amount of each gas present in the mixture.

V. By removing the experimental tube a little further away from the split of the spectroscope, the combined spectrum was reduced to the two bright lines.

VI. By reducing the temperature, all spectroscopic evidence of the nitrogen vanished; and, by increasing it, many new nitrogen lines made their appearance, the hydrogen line always remaining visible.

The bearing of these latter observations on those made on the nebulæ by Mr. Huggins, Father Secchi, and Lord Rosse is at once obvious. The visibility of a single line of nitrogen has been taken by Mr. Huggins to indicate possibly, first, "a form of matter more elementary than nitrogen," and which our analysis has not yet enabled us to detect; * and then, secondly, "a power of extinction existing in cosmical space."†

Our experiments on the gases themselves show not only that such assumptions are unnecessary, but that spectrum analysis here presents us with a means of largely increasing our knowledge of the physical constitution of these heavenly bodies.

Already we can gather that the temperature of the nebulæ is lower than that of our sun, and that their tenuity is excessive; it is also a question whether the continuous spectrum observed in some cases may not be due to gaseous condensation.

* Abstract of a paper read before the Royal Society, June 10th, 1869.

ON THE ELECTROLYSIS OF NITRATES.

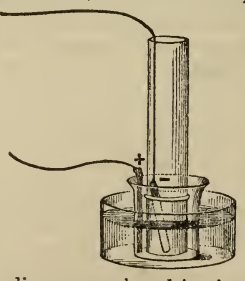
BY THOMAS BLOXAM,
LECTURER ON CHEMISTRY, CHELTENHAM COLLEGE.

The conversion of nitric acid into ammonia by the well-known method of boiling with zinc, iron, and potash, practised by Mr. Harcourt, suggested the idea of such conversion being possible with the hydrogen furnished by means of electrolysis. An experiment of the following nature proved the possibility in a qualitative sense:—Into a small porous earthen cylinder, 1 inch in diameter and 1½ inches high, was placed a little dilute nitric acid, the negative pole of a three-cell arrangement of Bunsen's battery was introduced, and the vessel placed in a small beaker, containing dilute nitric acid and the positive pole of the battery.

The liquid was withdrawn from the cylinder in about half an hour, and the usual test of boiling with excess of potash was tried, when the ammonia was easily detected by the odour and its action upon test-paper.

Nitrate of potassium was substituted for the dilute nitric acid in the porous vessel: ammonia was easily detected in this case also. Nitrate of potassium solution was acidulated with hydrochloric acid, and submitted to voltaic action for an hour. The solution was mixed with bichloride of platinum, and evaporated to dryness, when a fair amount of the double chloride of platinum and ammonium was obtained. This precipitate was examined, and found to be entirely pure.

The question then suggested was, whether any quantitative result could be obtained. For this purpose the porous cylinder used in the previous experiments was cemented to a glass tube, of the same diameter and 6 inches long, in order that any splashings caused by the escaping bubbles of gas should not cause an error. The compound tube was placed in a beaker, high enough to take the porous vessel, and just large enough to admit the positive pole. The tube and beaker were placed in a moderately large vessel of cold water, to keep down the temperature, which, in a previous experiment, had softened the cementing material joining the tube and porous vessel. The arrangement is represented in the figure. A weighed amount of pure nitrate of sodium was placed in the porous vessel, and submitted to electrolysis, the ammonia being estimated as the double chloride of platinum and ammonium.



From a considerable series of experiments, the amount of double chloride yielded was found to be below the

* *Phil. Trans.*, 1864, p. 444. † Ibid., 1868, p. 544.

calculated result. Several modifications were then tried; such as dropping the solution of the nitrate very slowly upon the negative pole, elevation of the temperature both of the solution and of the battery; reduction of the resistance offered to the voltaic battery. It is to be regretted, however, that, in spite of a fairly extensive series of experiments with these various modifications, I have only succeeded in converting half the nitrate into ammonia. It has been also proved that no loss of liquid takes place through the porous vessel.

I have been induced to make known these results with the hope of obtaining some suggestion which may solve the difficulty of the non-conversion of the other half of the nitrate.

ON THE

ACTION OF HYDROCHLORIC ACID ON MORPHIA.*

BY AUGUSTUS MATTHIESSEN, F.R.S.,
LECTURER ON CHEMISTRY IN ST. BARTHOLOMEW'S HOSPITAL,
AND C. R. A. WRIGHT, B.SC.

When morphia is sealed up with a large excess of hydrochloric acid, and heated to 140°—150° for two or three hours, on opening the tubes after cooling no gas is found to have been formed, nor is there any formation of chloride of methyl. The residue in the tube contains the hydrochlorate of a new base, differing considerably in its properties from morphia. It may be obtained in a state of purity by dissolving the contents of the tube in water, adding excess of bicarbonate of sodium, and extracting the precipitate with ether or chloroform, in both of which the new base is readily soluble, whilst morphia is almost insoluble in both menstrua. On shaking up the ethereal or chloroform solution with a very small quantity of strong hydrochloric acid, the sides of the vessel become covered with crystals of the hydrochlorate of the new base. These may be drained from the mother liquors, washed with a little cold water, in which the salt is sparingly soluble, and re-crystallised from hot water and dried on bibulous paper or over sulphuric acid.

This hydrochlorate contains no water of crystallisation. After drying in the water-bath, it yielded results on combustion with chromate of lead and oxygen agreeing with the formula $C_{17}H_{17}NO_2HCl$.

From a solution of the hydrochlorate in water, bicarbonate of sodium precipitates a snow-white non-crystalline mass, which speedily turns green on the surface by exposure to air, and is therefore difficult to obtain dry in a state of purity. This precipitate is the base itself.

It hence appears that the new base is simply formed from morphia by the abstraction of the elements of water.

Morphia. New base.
$$C_{17}H_{19}NO_3 = H_2O + C_{17}H_{17}NO_2.$$

We propose to call the new base apomorphia, for reasons given subsequently.

When the hydrochlorate of apomorphia in a moist state is exposed to the air for some time, or if the dry salt is heated, it turns green, probably from oxidation, as the change of colour is accompanied by an increase of weight. The base itself, newly precipitated, is white, but it speedily turns green on exposure to air. The green mass is partly soluble in water, communicating to it a fine emerald colour—in alcohol yielding also a green tint, in ether giving a magnificent rose-purple, and in chloroform with a fine violet tint.

The physiological effects of apomorphia are very different from those of morphia; a very small dose produces speedy vomiting and considerable depression, but this soon passes off, leaving no after ill effects,—facts of which we have repeatedly had disagreeable proof while working with it.

Dr. Gee is now studying these effects, and has found that 1-10th of a grain of the hydrochlorate subcutaneously injected, or ½ grain taken by the mouth, produces vomiting in from four to ten minutes. Our friend Mr. Prus allowed himself to be injected with 1-10th grain, which produced vomiting in less than ten minutes. From Dr. Gee's experiments on himself and others, he concludes that the hydrochlorate is a non-irritant emetic and powerful anti-stimulant. As from these properties it appears probable that it may come into use in medicine, we have called it apomorphia, rather than morphinine, to avoid any possible mistakes in writing prescriptions.

* Abstract of a paper read before the Royal Society, June 10th, 1869.

CONTRIBUTIONS TO ANALYTICAL CHEMISTRY.*

BY DR. E. FLEISCHER, OF DRESDEN.

Estimation of Baryta, Strontia, and Lime.

The estimation of these three alkaline earths is generally effected after they are separated from each other. These separations can be dispensed with if the indirect method be employed, thereby avoiding the loss attendant upon different separations, and materially hastening and simplifying the whole estimation. The following indirect method, which has proved to be the most preferable for the estimation of these three bases, may also be employed in the presence of magnesia. In the first place, the lime, strontia, and baryta, must be precipitated as carbonates, by means of carbonate of, and caustic, ammonia. The following is worthy of remark:—It is well known that, in a liquid containing much sal-ammoniac or nitrate of ammonia, neither lime, strontia, nor baryta will be completely precipitated by carbonate of ammonia; so that, after filtering, it is possible, by means of sulphuric acid or oxalate of ammonia, to recognize a more or less considerable quantity. The cause of this phenomenon is, that ammoniacal salts of strong acids have a solvent action upon carbonate of lime, which effect is still stronger upon carbonates of strontia and baryta. Should, on the other hand, acetate or carbonate of ammonia be used, instead of sal-ammoniac or nitrate of ammonia in solution, the precipitation of the three bases by carbonate of ammonia will be so complete that it will be impossible to discover in the filtrate, by means of the before-mentioned reagents, any traces of lime, strontia, or baryta.

In order to have in solution no other ammoniacal salts than acetate and carbonate of ammonia, it will suffice to add to the tolerably neutral solution as much acetate of soda as there is supposed to be sal-ammoniac or nitrate of ammonia held in solution, and then to supersaturate with ammonia and carbonate of ammonia, and, after a short digestion, to cool the solution; the carbonated alkaline earths which have in this manner been completely precipitated are now filtered off.

Digestion is not absolutely necessary here; it only serves to render deposits granular, which would other-

* Communicated by the Author.

wise be voluminous. On the other hand, in order to obtain complete precipitation, it will be necessary to reduce the whole to the ordinary temperature before filtering, because hot acetate of ammonia has a solvent action upon carbonated alkaline earths, although in a far less degree than sal-ammoniac.

A certain degree of dilution of the ammoniacal salt is to be recommended; in any case, the solution must not be more concentrated than in the proportion of one salt to twenty water. According to rule, I manage so as to dilute the digested mass with its own volume of distilled water, allowing it to cool still further before filtration.

The carbonate of soda may be substituted for the acetate, in order to decompose the sal-ammoniac; but if, at the same time, magnesia be held in solution, the presence of much salts of ammonia, with stronger acids than carbonates, will be necessary in order that it may not be deposited with the alkaline earths. For this purpose, the addition of acetate of soda is eminently suitable; because the acetate of ammonia thus formed (as with oxygenated salts of ammonia generally) prevents the precipitation of the magnesia much more than sal-ammoniac does, without, as before remarked, dissolving baryta, strontia, or lime.

In the presence of magnesia, a too great excess of carbonate of ammonia must be avoided as a reagent, in order to hinder the formation of ammoniacal carbonate of magnesia, which is difficult to dissolve. After these precautionary measures, the baryta, strontia, and lime having been separated (also from magnesia, if such be present), the deposit is washed, filtered, dried, heated, and weighed; it is then dissolved in a measured quantity of normal muriatic acid and estimated. This is done, after removing the carbonic acid by digestion, from the diluted solution (which is coloured with litmus) by estimating with one-half normal ammonia the amount of muriatic acid which had been required to transform the three carbonated salts into chlorides. The solution is now mixed with bichromate of potash and caustic ammonia in excess, to precipitate all baryta, so that no trace of it may be detected in the acidulated filtrate, by fluo-silicate of potash and spirit of wine.* The chromate of baryta is filtered off, and washed until sugar of lead ceases to give a yellow precipitate in the solution which runs through; to this chromic acid is now added, according to the known process, together with a measured quantity of a standard solution of green vitriol; and the amount of baryta is then obtained, according to the formula—

$$CrO_3 \times 1{,}527 = BaO.$$
$$\text{or } CrO_3 \times 1{,}964 = BaOCO_2.$$

If, on the one hand, the amount of carbonate of baryta thus obtained be deducted from the weight of the three carbonates, and, on the other, the amount of muriatic acid answering to the baryta be calculated, the difference between this amount of HCl and the amount found will be the quantity of muriatic acid which corresponds to the united weight of CaO,CO_2 and SrO,CO_2, which has just been calculated. The amount of carbonate of lime and carbonate of strontia is obtained as follows:—

Calculate the amount of carbonate of lime which is equivalent to the known quantity of HCl contained in the excess of $CaOCO_2$, and $SrOCO_2$; deduct this from the weight of the two carbonated salts, and multiply the remainder by the constant factor $3\frac{1}{12}$, and the product will then be the required quantity of $SrOCO_2$; this, when again subtracted from the united weight of both salts, yields, as its remainder, the quantity of carbonate of lime. The constant factor, $3\frac{1}{12}$, may be obtained by the following calculation:—

	$CaOCO_2 =$	50
	$SrOCO_2 =$	74
	$CaOCO_2 + SrOCO_2 =$	124
hence	$2CaOCO_2 =$	100

and the remainder, 24, in the equivalent of $SrOCO_2$, equal to 74, yields, when divided, $S = \frac{74}{24} = 3\frac{1}{12}$.

This method of estimating these three alkaline earths always yielded very satisfactory results. One advantage is that it is quickly carried out and also very exact, because the precipitations will be all perfect, and the two volumetric estimations involved in the method admit of great exactitude. Moreover, the troublesome and somewhat uncertain separation of the strontia and lime with a concentrated solution of sulphate of ammonia is avoided, and which is very inconvenient in estimating the lime. In the absence of strontia, I either precipitate the lime and baryta as carbonates,* estimating the precipitate alkalimetrically; or I precipitate the baryta as sulphate, the lime as carbonate, by digesting the solutions of both with a mixture of three parts of sulphate of potash and one part of carbonate of potash; weigh the dried and ignited precipitate, and estimate the carbonate of lime alkalimetrically.

Normal Liquids for Volumetric Analysis.

In the greater number of analytical examinations of free acids and alkalies, the rule is to employ a normal acid, and a normal solution of caustic potash, and also a tenfold dilution of them (1-10th of the normal liquids). In choosing the most appropriate acid for this purpose, it must be taken into consideration that it should form with alkalies or alkaline earths only soluble salts, in order that certainty in discerning the change of colour in the liquid under examination—which is coloured with litmus—may not be injured by precipitates, and also that the carbonates of the alkaline earths may be perfectly transformed by the normal acid. On this account, nitric acid is much more useful as a normal liquid than sulphuric or oxalic acid; but hydrochloric acid is quite as appropriate as a standard solution as nitric acid, and more so, inasmuch as it is more easily obtained pure, and is more constant to one standard, while nitric acid is generally more or less contaminated by nitrous acid. Another advan age possessed by hydrochloric acid is, that the acid contained in it may be not only estimated alkalimetrically, but also quickly and exactly by a standard silver solution, a trial which is impossible in the case of nitric acid.

With regard to volatility, it is to be mentioned that hydrochloric acid, diluted to one-fifth of the normal strength, when heated for ten minutes, whilst replacing the evaporating water, will not impart the slightest tinge of red to a blue litmus paper held in the vapours evolved, and, as in alkalimetric investigations the dilution is much greater, there need not be any fear of ever driving off the free acids by digestion. Moreover, since the constancy of normal hydrochloric acid is so great that, after keeping for months, the slightest change can scarcely be perceived, provided it has been preserved in bottles

* Pure chloride of barium solution, also, produces no turbidity when, after the precipitation of baryta by chromate of potash and ammonia, the filtrate is mixed with sulphuric acid. It is, of course, understood that the reagents employed in precipitation are quite free from sulphuric acid.

* Especially when magnesia is present.

well closed with glass stoppers, no impediment exists in this respect to its employment as a standard liquid.

It is well known that many chemists besides myself have performed these experiments successfully with normal hydrochloric acid, and that, in all alkalimetrical determinations, they already use it instead of normal sulphuric or oxalic acid; it is hoped, therefore, that these remarks will suffice to demonstrate the utility of this testing liquid.

The second important normal solution for analysis by saturation is normal caustic potash or soda. These caustic liquids should be completely and absolutely free from carbonic acid, and, in order to prevent them from absorbing this gas from the air, a mixture of Glauber's salt and caustic lime is employed. This is contained in a tube fastened into the stopper of the bottle which contains the alkali; but this precaution does not always suffice to retain the solution of caustic alkali perfectly free from carbonic acid, for it almost always happens that an addition of a solution of chloride of barium to it produces a precipitation of carbonate of baryta in greater or smaller proportion. The preservation of caustic alkali by this means is also inconvenient, as, on account of the syphon in the bottle, it requires to be placed over the working bench, and can, therefore, only be protected from the dust by a special cover. To these drawbacks may, perhaps, be ascribed, in technical laboratories, the frequent substitution of the more easily preserved, though less appropriate, solutions of carbonate of potash or soda for the caustic alkaline solution as a normal standard liquid.

All these inconveniences, which exert more or less influence upon the exactitude of estimation, may, however, be remedied by employing, instead of the normal potash or soda solution, caustic ammonia of half the normal strength. Of all caustic solutions, caustic ammonia displays the most complete indifference to carbonic acid; so complete, in fact, that a flask half filled with half normal ammonia, well closed with a glass stopper, and which was frequently opened for estimations to be made, gave such slight indications of carbonic acid after three months' preservation, that, upon half filling a large test-glass with it, and adding some drops of concentrated acetate of lime, no perceptible turbidity ensued, even on heating; whereas two bubbles of carbonic acid gas introduced into it from a gasometer instantly produced a considerable deposit. Moreover, the standard of this half-normal liquid was so slightly altered during the three months, that 1-10th c.c. of a tested normal muriatic acid was scarcely less saturated by 50 c.c. of it, than would have been necessary by an exact standard.

It follows from these experiments that the half-normal ammonia liquid is at least as useful in acidimetrical work as the best caustic potash solution; besides which the former has the advantage of being conveniently preserved, and of being easily obtainable chemically pure.

With respect to the importance of the appearance of a blue colouration of the litmus by a liquid reddened by free acid, so as to fix the final reaction in analysis by saturation, the following is worthy of remark:—

Cold diluted (to at least 1 : 10) solutions of neutral sulphate or nitrate of ammonia scarcely produce any perceptible change in blue litmus paper—at any rate, much less than that produced by the introduction of two bubbles of carbonic acid. Sal-ammoniac reacts, under these circumstances, as neutrally as chemically-pure chloride of potassium, or chloride of soda; and a single drop of half-normal ammonia produces in such litmus-coloured solutions a strong and lasting blue colour, slightly inclining towards violet.

Hot solutions of the ammoniacal salts in question, and especially sulphate of ammonia, act upon litmus in a somewhat acid manner, about the same as free carbonic acid; hence it follows that, in all estimations by ammonia, the liquid to be tested should be cold. Should it have been previously heated, it is advisable that it should be cooled as much as possible by first exposing it for some minutes to the air, and then setting it in cold water. If this be attended to, the distinctness of the tint will leave nothing to be desired. The objection may be raised, that ammonia cannot be employed, like potash or soda, as a normal, but only as a half-normal, liquid; the relation of the base to the acid as 2 : 1 is, however, more advantageous to the exactness of the determination than if both fluids possessed the same equivalents.

As all volumetric estimations, excepting those of such caustic liquids as caustic soda, potash, baryta, and ammonia, are finished by re-estimating the acid with ammonia, and, as 1 c.c. of normal muriatic acid corresponds with 2 c.c. of half-normal ammonia, the re-estimation is much more exact than if solutions were used containing equal equivalents. The usual 1-10th normal solutions may also hereby be dispensed with in almost all cases, if the experiments be carefully carried out. These remarks will demonstrate that I can specially recommend the employment of half-normal ammonia and of normal muriatic acid as standard liquids for analysis by saturation; at the same time, I may observe that, for testing acids combined with metallic salts, I employ normal potash, supersaturating with a measured quantity of muriatic acid the free potash present in an aliquot part of the filtrate, calculating the combined acid after removing the carbonic acid by heat, and re-estimating with ammonia.

The standard of the normal muriatic acid is ascertained by a weighed amount of pure carbonate of lime, slightly heated. The best way to preserve both liquids is in well-closed flasks, with glass stoppers. They should be placed in a cool place, free from dust. In hot summer weather, the flask containing the half-normal ammonia should be placed in cold water, which should be renewed daily, because a continued temperature of 25° C. will alter its standard, though only in a slight degree.

THE FARADAY MEMORIAL.

The Faraday Lectureship has been worthily inaugurated. M. Dumas, representing not alone the chemists of France but the chemists of Europe, has given us a lucid and comprehensive discourse, in which he has surveyed, from our present stand-point, the position of chemistry and its relations with past science, and has, moreover, pronounced an admirable *éloge* of him whom the discourse commemorates. No one could be more eminently fitted than M. Dumas to undertake this duty: he was the intimate friend of Faraday, and with him he somewhat connects the chemistry of the past with the chemistry of our day; he stands pre-eminent among the chemists of his country, and has had much influence upon the entire *cultus* of France during the last quarter of a century. And what are his relations with the past? He was born a few years after the death of Lavoisier; at the time when he entered the chemical world the system of Lavoisier was firmly established, was universally accepted. He may have seen as a boy the death

of Phlogiston—that slow, long-drawn-out death, not with gasping and a discoloured visage, not with a strong clinging to life and mortal strugglings; it was rather the death of the aged and worn-out, almost a euthanasia. Phlogiston died as an old king, once infinitely dominant, somewhat tyrannical, not always just; now deposed, decrepit, utterly senile, forsaken by all, and ever harping upon his former glories. It was Lavoisier who founded the new dynasty, of which ours is as much a continuation as was the dynasty of Elizabeth of that of Henry VII. The times have changed, the *modus* of thought has changed, characteristic developments have assumed new features, and appeared with altered and contingent phases, but the basis is the same—it is firm and immutable as to its facts; and all philosophy, of what kind soever it be, all science, all social actions, are alone stable when they are founded upon the immutability of fact. We were glad to notice that M. Dumas made much mention of Lavoisier in his discourse; but not glad to observe that, while the names of Davy and Dalton were received with applause, that of Lavoisier was passed in silence. This is ungenerous and illiberal. We need not go quite so far as M. Wurtz, in his recent "History of Chemical Theory," but let us at least acknowledge to the full that which Lavoisier has done for chemistry. In neglecting him, we not only act unjustly, but we injure ourselves; for, did not Lavoisier confess himself the pupil of Black? And, as to the arrogance attributed to him in regard to the name of his chemistry, it seems to be forgotten that Fourcroy introduced the term *La Chimie Française;* it was a just term, and, till lately, no one has complained of it. Does not Davy speak of the "new French chemistry?" Let us forget these petty jealousies. The very institution of the Faraday lectures will, by establishing cordial unions between scientific men of foreign countries and those of our own, help to dissipate these feelings, and to produce a more complete *entente cordiale.* Meanwhile, let us express for Lavoisier, in the words of M. Dumas (in his admirable "Leçons sur la Philosophie Chimique"), "notre profonde admiration pour son génie, et notre douleur éternelle pour sa mort prématurée." And let us express, for M. Dumas himself, the first of these sentiments, and thank him for having come among us: this man, who was a great chemist before many of us were born; who, more than forty years ago, wrote a many-volumed work on chemistry, which has been the text-book of a generation or so of young chemists; and who has ever furthered and adorned our science.

A word or two, about the medal which accompanies the Faraday lectureship. Of the design, and the legend which accompanies it, we fear we cannot speak in great praise, and therefore shall not speak at all; but some may be interested in knowing that the medal is to be struck in palladium, and that a quantity of this rare metal, sufficient for the medals of at least ten years to come, has just been presented to the Chemical Society by an eminent metallurgical firm. And, *àpropos* of this, we may mention that M. Dumas carries back to France with him, in addition to the Faraday medal, a medal of the alloy of palladium and hydrogenium to commemorate the discovery of the latter by the Master of the Mint.

It is a matter of much satisfaction to know that at length steps have been taken to provide a memorial to Faraday in another form. While the lectureship and medal are the special memorial of the Chemical Society, this is to be the memorial of the country at large, and it is proposed that it should take the form of a statue. That the Government have held aloof from taking any part in this memorial is much to be regretted, but the Chancellor of the Exchequer has stated that he is only following precedent in not allowing public moneys to be expended on a memorial to a "private citizen." But was Faraday a *private citizen?* In one very limited sense, indeed, he was, but, in point of fact, he was a cosmopolitan. "Faraday," said M. Dumas, "n'appartient pas seul à l'Angleterre, il appartient à tout le monde." A private citizen! Who has worked more for the public good? Who has more promoted works for the weal of his country, for the welfare of his race? We hope that not only the scientific men of this country will promote the Faraday memorial, but that the whole country will subscribe to it, and that we may have not alone a statue to this great man, not alone the lectureship and medal, but some greater work, and we would suggest, as we have before done, that it should take the form of a Public Laboratory, which would afford to those who have longings for science, but who lack opportunity, a means of satisfying the yearnings of their genius. To those who "fall gloriously fighting" in the service of their country,—to those who in the Senate have promoted large interests, successful negotiations, an honourable peace, or a triumphant war,—the country and the Government never fail to raise memorials, and to give honour: let them honour him who, working quietly, and steadily, and firmly, has added so much to the internal wealth of this country, so much to the scientific literature of the world. Faraday ever held in his hand "Lampas investigationis, non torris contradictionis," and the bright steadfast light illumines all that he did, and enveloped him as he passed untimely from our sight.

ON THE

ACTION OF HYDROCHLORIC ACID ON CODEIA.*

BY AUGUSTUS MATTHIESSEN, F.R.S.,
LECTURER ON CHEMISTRY IN ST. BARTHOLOMEW'S HOSPITAL,
AND C. R. A. WRIGHT, B.SC.

Codeia was sealed up with from twelve to twenty times its weight of strong hydrochloric acid, and heated to about 140° for two or three hours. After cooling, a layer of colourless liquid was observed floating on the top of the brown tarry contents. It immediately became gaseous on opening the tubes, and was presumedly chloride of methyl, as the issuing gases were found to be free from carbonic acid. The residue in the tubes, when dissolved in water and precipitated by carbonate of sodium, yielded, on extraction with ether and agitation with hydrochloric acid, a crystalline chloride, having, when purified by recrystallisation, all the properties of the chloride of apomorphia derived from morphia. It gave the same qualitative reactions, produced the same remarkable physiological effects, and yielded numbers on combustion with chromate of lead and oxygen agreeing with the formula $C_{17}H_{17}NO_2HCl$. Hence the reaction which takes place is in accordance with the formula—

Codeia. Apomorphia.

$$C_{17}H_{17}CH_3HNO_3+HCl=CH_3Cl+H_2O+C_{17}H_{17}NO_2.$$

* Abstract of a paper read before the Royal Society, June 10th, 1869.

ON THE

ATOMIC WEIGHTS OF GOLD, PLATINUM, IRIDIUM, OSMIUM, RHODIUM, AND PALLADIUM.

BY W. M. WATTS, D.SC., F.C.S.

The atomic weight of gold was determined by Berzelius from the analysis of its double chloride with potassium. He obtained, as mean result, the number 196·67, which was calculated from the weight of potassium chloride left, assuming its atomic weight=74·57. My pupil, Mr. R. A. Jones, has pointed out that, since Berzelius determined in each case not only the potassium chloride left, but also the metallic gold set free, we have data for calculating both the atomic weight of gold and also that of potassium; so that, by comparing the atomic weight of potassium calculated from Berzelius's numbers with that given by the marvellously accurate researches of Stas, we are able to estimate the degreeof accuracy of Berzelius's results. Berzelius obtained (*Lehrbuch der Chemie*, iii., 1212), in four experiments, the following results:—

	$AuKCl_4$. Grs.		KCl. Grs.		Au. Grs.
(1).	4·14450	gave	0·81850	and	2·15900
(2).	2·24950	"	0·44425	"	1·17200
(3).	3·41300	"	0·67400	"	1·77725
(4).	4·19975	"	0·82950	"	2·18800

Calculating from Stas's number for chlorine, viz., 35·457, we obtain the following atomic weights for potassium and gold:—

No. of Experiment.	Atomic weight of Potassium.	Atomic Weight of Gold.
1	39·149	196·79
2	39·166	196·87
3	39·088	196·57
4	39·176	196·86

If we select experiments 3 and 4 as the best, and take the mean, we have K=39·132, and Au=196·71.

The extremely close agreement of the numbers for potassium with that given by Stas, viz., 39·133, can be considered as little less than marvellous, and may, I think, be regarded as investing the atomic weight of gold with authority scarcely less than could be obtained by a repetition of the determinations, with all the minute precautions which Stas employed in his experiments.

It must not be forgotten, however, that in this way we check only the accuracy of manipulation, but obtain no evidence of any error arising from impurity of the metal employed.

I have applied the same criticism to the results obtained in precisely the same way for platinum, iridium, osmium, rhodium, and palladium, none of which, however, exhibit the accuracy of the gold determinations; and the best result is probably obtained by calculating from the atomic weight of potassium chloride instead of from chlorine alone.

The results are subjoined—

	Calculated from Cl=35·457.		Calculated from KCl=74·59.	Authority.
Platinum	K=39·35	Pt.=197·75	Pt.=197·18	Berzelius
Iridium	K=39·39	Ir.=197·54	Ir.=196·87	"
"	K=39·87	Ir.=198·56	—	Claus
"	K=39·93	Ir.=196·62	—	"
Osmium	K=39·28	Os.=199·42	Os.=199·03	Berzelius
Rhodium	K=39·12	Rh.=104·21	—	"
"	K=39·89	Rh.=104·76	—	"
Palladium	K=39·62	Pd.=107·19	Pd.=106·57	"

Manchester Free Grammar School,
June 18th, 1869.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

June 3rd, 1869.

DR. W. A. MILLER, V.P.R.S., &c., *in the Chair*.

The minutes of the preceding meeting having been read and confirmed, the following certificates were read:—

For the first time—John Morrison, Analytical Chemist, County Wicklow, Ireland; W. G. Lewis, Fellow of Oriel College, Oxford; Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland.

For the second time—Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. Fletcher Barrett, Lecturer on Physical Science at the London International College.

For the third time—William G. Valentin, Assistant in the Royal College of Chemistry, 126, Lancaster Road, Notting Hill; Thomas Gilham Hewlett, Surgeon, Bombay; Captain A. Noble, Engineer, Elswick Ordnance Works, Newcastle; H. Stillington Grey Stephenson, B.A., Oxford, Sympsham Rectory, Weston-super-Mare. The last named gentlemen were balloted for and duly elected.

Mr. Gerstl was proposed as an associate of the Society.

The PRESIDENT (Dr. Williamson) then read a lecture on "*The Atomic Theory*," but, as it is difficult for us to give a condensed report which will do justice to so important a subject, and as the author has, with his usual courtesy, kindly promised to send us an abstract, we postpone our report of this paper for a future number.

The CHAIRMAN proposed a vote of thanks to Dr. Williamson, and said that it would be better to defer the discussion until the next meeting. He would, however, remark that those who opposed the atomic theory must explain how, according to the notion of the infinite divisibility of matter, they had combination in definite proportion at all. It seemed to him utterly impossible to explain combination in definite proportion by the theory of infinite divisibility.

The PRESIDENT announced that, as the next meeting would be taken up by M. Dumas's lecture at the Royal Institution, another meeting would be held for the ordinary business of the Society; the date was not, however, announced.

The meeting then adjourned till the 17th inst., at the Royal Institution.

Meeting held at the Royal Institution, June 17th, 1869.

DR. A. W. WILLIAMSON, F.R.S., *President, in the Chair*.

The minutes of the previous meeting were read and confirmed, and the following certificates read:—

For the first time—E. A. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

For the second time—John Morrison, Analytical Chemist, County Wicklow, Ireland; W. G. Lewis, Fellow of Oriel College, Oxford; Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland.

The PRESIDENT then addressed the meeting as follows:—

The Society is here assembled to inaugurate what would be inadequately described as a monument in honour of Faraday. The Faraday Lectureship has been founded by the Council of the Chemical Society in the hope that it will promote the advancement of human knowledge, and surely no higher tribute of respect could be paid to a great man than to do in his name what he would have loved best to see done. Now, among the arrangements which are made for the promotion of interchange of ideas—ideas which are so essential to those who are working in the investigation of nature—there is one particularly important defect and shortcoming. We have books and papers which circulate throughout the length and breadth of the civilised world, and in each country there are Societies where men meet together to consider and discuss questions relating to science, and to aid and encourage one another in various ways. But these

books and papers give but the skeleton of a science without that life and interest which is imparted to facts when communicated by a discoverer himself. And, on the other hand, Societies, although they do much for the promotion of science, leave still more undone. It is an essential of truly philosophical work that questions be viewed from various sides; and those who have followed with any attention the recent history of our young science, must have been struck with the variety of lines of thought followed simultaneously by independent workers—lines of thought which finally converge in certain general truths; their convergence serving to corroborate the evidence of those truths, and to establish more perfectly the conclusions which are thus arrived at. Now, the greatest difficulty which is experienced, and the greatest defect which one observes, is this, that workers in one line of thought are too frequently ignorant, or insufficiently cognizant of what others are doing; and the defect shows itself chiefly between those who are working in different countries, more than between those who are working in the same country. Now, imagine that we could induce to come among us a man possessed of one of those master minds which forms a focus of light throughout science, and amongst all those who are interested in science: suppose that he were to tell us the thoughts which are uppermost in his own mind, and—best of all—that he were to make us for a time think with him in the very words of his own language: imagine that such a highly gifted man combined in his own person the genius of a discoverer, the breadth of intellect of a philosopher, and the lucid fluency of an orator. I am sure that you would agree with me, that his visit would inaugurate something which Faraday would truly have rejoiced to see. Imagine, I say, those things: accurately fix in your mind's eye the image of such a man—and Dumas is before you! [Loud applause.]

M. Dumas, La Société vous reçoit comme le plus illustre representant du progrès de notre science. Nous sommes heureux et fier de vous avoir parmi nous,—heureux de vous voir et de vous entendre, fier de ce que vous êtes venu au nom de Faraday. Je vous presente cette medaille qui a été frappée en commemoration de votre visite, et je vous prie de conscrver avec elle le souvenir de cette réunion.

M. Dumas's lecture* commenced with a brief *éloge* of his friend, the late Professor Faraday. The Lecturer then, with admirable eloquence, passed to the consideration, first, of what he termed "*la matière brute*," and of its forces; and, secondly, of organic matter and the forces special to it. He traced the origin of some of the more important modern chemical doctrines to the labours of the Greek philosophers, and identified the principle of the ancient classification into fire, air, earth, and water, with that of Lavoisier's chemical elements. He acknowledged his great admiration of the labours of Dalton and Prout, and in a most lucid manner pointed out relations between the atomic weights of the now received elements which led him to infer the probability of many of them having a common basis. The audience was reminded that many years ago M. Dumas had contended that organic bodies are constituted in a manner similar to mineral bodies, and he took occasion to show how the progress of chemical research had confirmed the truth of this view, he himself being disposed to limit the term "organic substance" to those very few compounds which take part in the growth of organized beings.

Professor Tyndall then spoke as follows:—Fellows of the Chemical Society, Ladies, and Gentlemen—It becomes my duty to ask you to return your best thanks to M. Dumas for the noble discourse which you have just heard; and I sincerely thank the President of our Society for giving me this opportunity of testifying to the respect and high regard which I personally entertain for our first Faraday lecturer, both as a man and as a philosopher. [Applause.] It is now, Sir, [turning to M. Dumas] one and twenty years since, in company with the gentleman who now sits at my side, I first heard your voice. It was in your own *College de France*, and to this hour I have not forgotten the impression that you then made upon me with regard to your clearness, your power, and your eloquence as an expositor of scientific truth. You then, Sir, were celebrated as an investigator, and, as I thought, you were in the very blossom of your strength; but, Sir, I was wrong. You have this night shown a vigour and a depth and a capability of grappling with great questions, such as I doubt whether you possessed in equal vigour twenty-one years ago. You have to-night, Sir, grappled with some of the weightiest questions which underlie both chemistry and physics, and which constitute, if I might be allowed the term, the very solder of the material universe; and you have, moreover, vindicated the claims of science to a higher recognition than that which may be fairly based upon the material results that flow from it. You have shown how it can connect itself with philosophy, and with the general culture of the human mind. Sir, the walls which here surround you are associated with immortal memories. For more than sixty years they have been accustomed to hear voices which have gone forth into all lands. They have heard the voice of the great Thomas Young, of Humphry Davy, and of Michael Faraday; and we, Sir, bid you welcome to the scene of their teachings and of their triumphs. [Loud applause.] We, Sir, wish with all heartiness that you may long preserve the vigour which you have here displayed to-night, employing it as you have just done, for the delight of your hearers, the honour of science, and the good of mankind. [Applause.]

Professor Odling: I feel it a great privilege, and at the same time a great difficulty, after the eloquent remarks of Dr. Tyndall, to second the vote of thanks to M. Dumas, which he has proposed. As an old officer of the Chemical Society I may say we all felt that we could not find a more fitting or more able inaugurator of the Faraday lectureship than M. Dumas; but we also found that we could not find anyone more willing—I might say more desirous—to make the sacrifice of time and convenience that was demanded of him in order to do honour to the memory of that great man whose name we are this night met to commemorate. I think, however, that our vote of thanks to M. Dumas for his eloquent address, and for his coming over among us to deliver it, must not be lessened by the consideration that it was impossible for him to surprise us, or at any rate those of us who know him, by any display of eloquence and any display of kindness, however extreme. I call upon you then, with every mark of enthusiasm, once more to show M. Dumas how much you appreciate his kindness in coming among us, and how much you feel the honour of his presence, and the benefit to be derived from his most eloquent address. [Loud and prolonged applause.]

The President: It is unnecessary to put the motion, for it has been carried by acclamation.

M. Dumas replied in a short but eloquent speech, and the President announced that another meeting of the Society would take place at Burlington House, on the 1st of July, when papers will be read by Mr. R. H. Smith and Dr. Phipson.

* We have purposely given only a short notice of Professor Dumas's oration, as a verbatim report will appear in our next number.

CHEMICAL SOCIETY DINNER

On the Occasion of the Inaugural Faraday Lecture by M. Dumas, June 18th, 1869.

In another part of this number we have given an account of the magnificent lecture by M. Dumas. We have here the pleasing duty of giving a brief account of the banquet given to the eminent philosopher and chemist on the evening after the delivery of his inaugural Faraday discourse. As may be supposed, there was a large attendance of Fellows of the Society, all of whom were anxious to do honour to the memory of Faraday, and also to show their esteem and admiration for one who was a personal friend of Faraday, and who occupies one of the highest places amongst our continental scientists. The chair was occupied by the

President of the Chemical Society, Dr. A. W. Williamson, F.R.S. The following is the list of stewards:—F. A. Abel, F.R.S.; T. Andrews, M.D., F.R.S.; E. Atkinson; J. Attfield, Ph.D.; J. Lowthian Bell; J. H. Brazier; Sir Benjamin C. Brodie, Bart., F.R.S.; A. Bernays, Ph.D.; D. Campbell; F. C. Calvert, Ph.D., F.R.S; E. T. Chapman; A. N. Church, M.A.; F. Claudet; W. Crookes, F.R.S.; H. Debus, Ph.D., F.R.S.; Warren De la Rue, Ph.D., F.R.S.; F. Field, F.R.S.; G. Cary Foster, F.R.S.; R. Galloway; J. P. Gassiot, F.R.S.; J. H. Gilbert, Ph.D., F.R.S.; J. H. Gladstone, Ph.D., F.R.S.; T. Graham, D.C.L., F.R.S.; G. Griffith; F. Guthrie, Ph.D; A. V. Harcourt, F.R.S.; D. Hanbury, F.R.S.; C. Heisch; F. C. Hills; T. H. Hills; Dr. Holzmann; Sir Robert Kane, M.D., F.R.S.; J. B. Lawes, Ph.D., F.R.S.; G. D. Longstaff, M.D.; A. Matthiessen, Ph.D., F.R.S.; J. Mason; H. Medlock; W. A. Miller, M.D., LL.D., V.P.R.S.; T. Morson, jun.; H. Müller, Ph.D., F.R.S.; S. Muspratt, Ph.D.; E. C. Nicholson; H. M. Noad, Ph.D., F.R.S.; W. Odling, F.R.S.; J. D. Perrins; W. H. Perkin, F.R.S.; Lyon Playfair, C.B., M.P., Ph.D., F.R.S.; D. Price, Ph.D.; E. Ronalds; E. Schunck, Ph.D., F.R.S.; E. Schweitzer; P. Spence; R. Angus Smith, Ph.D., F.R.S.; J. D. Smith; J. Stenhouse, LL.D., F.R.S.; A. Smee, F.R.S.; A. Smee, jun.; J. C. Stevenson; C. Tomlinson, F.R.S.; J. L. Thudichum, Ph.D.; R. V. Tuson; J. Tyndall, LL.D., F.R.S.; J. A. Voelcker, Ph.D.; P. J. Worsley; G. F. Wilson; J. Williams; Col. P. Yorke, F.R.S. After the usual loyal toasts, the Chairman eloquently proposed the toast of the evening, "The Health of Professor Dumas," and spoke of his high scientific skill and attainments in terms which were enthusiastically received by the company; and the health of the guest was drunk with the usual honours, and amidst tremendous applause. M. Dumas replied in a fluent and brilliant speech, in which he alluded with great pathos and feeling to Faraday, and also spoke of the pleasure it gave him to accede to the invitation of the President and Council to deliver the inaugural Faraday Lecture. Several other toasts followed, which were appropriately acknowledged, and the speeches were interspersed with a selection of music performed by the band of the Coldstream Guards. The arrangements were exceedingly good, and the way in which they were carried out reflects great credit on the executive committee. The evening was a most agreeable one to all present, and we hope that M. Dumas will long remember the delight and enthusiasm with which he was welcomed to the scene of Faraday's labours. We are certain that the Society will never lose the remembrance of his grand and stirring oration, which will always be associated with the courtesy and kindness displayed by the Master of the French Mint during his short visit amongst us. It only remains for us to hope that for many years we may gain as much pleasure and profit from the Faraday Lectures as we have from this—the inauguration of our memorial to England's great philosopher.

PROPOSED MEMORIAL TO FARADAY.

On Monday last, a public meeting was held in the theatre of the Royal Institution, Albemarle Street, for the purpose of considering what measures shall be taken for the promotion of a memorial to Professor Faraday, whose voice was so often heard as a lecturer within those very walls. The chair was taken at half-past three by his Royal Highness the Prince of Wales, who was supported by M. Dumas, Count Strelecki, General Sabine (the President of the Royal Society), Sir Henry Holland (President of the Royal Institution), Sir Roderick Murchison (President of the Royal Geographical Society), Sir Charles Wheatstone, Professor Williamson, Admiral Manners, Colonel Yorke, Professor Frankland, Mr. De la Rue, Mr. Frederick Pollock, Dr. Gladstone, Mr. Cæsar Hawkins, Dr. Holtzmann, Dr. H. Bence Jones (Secretary to the Committee), Dr. Lyon Playfair, M.P., Professor Tyndall, Professor Graham (the Master of the Mint), Sir John Lubbock, Sir Benjamin Brodie, Mr. Gassiot, Professor Miller, and a number of other distinguished personages, both English and foreign. The Astronomer Royal, Sir John Herschel, the Marquis of Salisbury, Mr. Layard, and other gentlemen who had been expected, sent letters to apologise for their absence.

The proceedings were opened by His Royal Highness, who, in a few well-chosen words, expressed the pleasure which it gave him, both on public and on private grounds, to preside over such a meeting as the present, and reminded his hearers that, although he whom they had met together to commemorate had been dead for nearly two years, yet nothing had been done by the public as yet to perpetuate his memory. Early in 1868, the Council of the Royal Society requested the President to take measures for the holding of a meeting to promote a monument to Faraday, and, with that view, the Secretary was instructed to write to the presidents of the following societies:—The Royal Society, the Geographical, the Linnæan, the Geological, the Royal Astronomical Society, and the British Association. On the 24th of March, a meeting of the presidents was held, and it was thought desirable, before proceeding further, to learn the views of Her Majesty's Government as to the erection of a monument as a recognition of his pre-eminent services to science and mankind. On the 22nd of June, Mr. Disraeli desired his secretary to say that he considered a monument to Faraday a proper object; but he suggested that its consideration should be left till next year. In the present year, the Chancellor of the Exchequer wrote saying that he had no doubts of the signal merits of Faraday, and he thought that a monument ought to be erected; but he could not consent to devote public money to a monument for a private citizen, however illustrious. He did not make this rule; he found it. On the 8th of June, it was resolved to hold a public meeting at the Royal Institution. Under these circumstances, the Council of the Royal Society, and the presidents of the various other learned societies, had resolved to take the matter seriously in hand without further loss of time, and the result was the present meeting, at which it gave him the greatest pleasure to take the chair.

The first resolution—"That it is desirable that measures should be taken to provide a public memorial to the late Professor Faraday"—was proposed in a short speech by General Sabine, who said that the Royal Society, over which he had the honour to preside, felt a pride and a pleasure in reckoning Michael Faraday as one of its members, and bore his testimony to the fact that, out of all its long list of Fellows, none had contributed such a valuable collection of papers to the *Philosophical Transactions*.

This resolution was seconded by M. Dumas, Senator, Member of the Academy of France, and Permanent Secretary of the French Institute. Mr. Dumas began by reminding his audience that Faraday, whose genius achieved so much in the cause of science, and, therefore, of civilisation generally, was one of the eight Foreign Associates of the Academy of Sciences of the Institute of France. He also said that it was with pleasure he himself had crossed the Channel to do homage to his memory, and that it was with a feeling of profound emotion that he now found himself standing in the place where his late great contemporary had stood so often. M. Dumas declared that in France Faraday commands as many admirers as in England, and that among these admirers the Emperor of the French stands foremost—so much so, indeed, that his Imperial Majesty never loses an opportunity of evincing his regard for the name of the great *savant*, after whom Paris had named a street, and whose discoveries have not only done honour to England, but have been of incalculable service to the interests of the world at large. M. Dumas then proceeded with great eloquence and perspicuity to touch in detail upon some of the scientific achievements of Faraday, and took occasion to observe that his genius, in its various applications of science to practical purposes, was distinguished by originality, not less than by profundity, instancing his condensation of gas into liquids, his manufacture of steel and of glass, his magneto-electric currents which encircle the world in the telegraph wires, and

his magneto-electric light, to be seen in the most important lighthouses of England and of France. M. Dumas wound up his speech by expressing, in a tone of deep emotion, his own personal regard for a man who was singularly distinguished by his virtues in private life. There were many present who sympathised with M. Dumas when he added that the world at large had cause to lament the loss of Faraday as one of the greatest philosophers who ever shed light upon it by the force of genius, but that he himself had still greater cause to lament in his death the loss of a friend.

Sir Henry Holland moved the second resolution,—"That the following gentlemen be a committee to take the necessary measures for the provision of the said public memorial in honor of Faraday: General Sabine, President of the Royal Society; Sir Henry Holland, President of the Royal Institution; Sir Roderick Murchison, President of the Geographical Society; Dr. Williamson, President of the Chemical Society; Mr. George Bentham, President of the Linnean Society; Mr. T. H. Huxley, President of the Geological Society; Admiral Manners, President of the Astronomical Society; Dr. W. J. Hooker, President of the British Association; the Right Hon. A. H. Layard, M.P., Mr. J. Ferguson, Mr. Gassiot, Dr. Tyndall, Mr. Grove, Dr. Frankland, Mr. De la Rue, and Dr. Bence Jones, with power to add to their number."

The resolution was seconded by Sir Roderick Murchison, who referred to the fact that in that very theatre, more than 60 years ago, he had seen Sir Humphry Davy make some of those experiments in electricity which now formed the basis of modern science; and that, standing on the very spot where the Prince now sat, Faraday year after year had carried on those experiments after his master's death, training two successive generations of disciples in the study of the laws of nature. He bore willing and grateful testimony to the extreme modesty and humility of the great man who for more than half a century had made that institution his home, and adverted to the fact that Faraday had first shown marks of his high genius within the walls of the Institution in the year 1823, when Mr. Brande being taken ill and unable to lecture, the duty of lecturing suddenly devolved on his assistant, whose simplicity, sincerity, and genuineness of character even then had begun to make themselves felt, and were but an augury of his after life.

Professor Owen moved the third resolution, to the effect "That a subscription, not exceeding five guineas in amount from any one person, be made for the provision of a public memorial to Faraday." He prefaced this resolution by a few remarks, to the effect that the theatre in which they were assembled was redolent of Faraday and seemed haunted by his spirit. Great and deep as was the learning which he displayed as a lecturer, still his profound and subtle generalisations were almost exceeded by that playfulness of wit by which he raised the intelligence of his hearers without lowering himself from the height of his professional dignity. Of his genius they had heard already from M. Dumas; but enough could scarcely be said of his personal merits, his singular modesty, and that unconsciousness of genius which is so often combined with genius of the highest order, as in Wellington. Like him, Faraday sought no honours, and all that he gained came to him unsought; but Englishmen feel that they all have a share in the achievements of both, and the reputation of the great philosopher, like that of the great warrior, is reflected on all his countrymen. Those, therefore, who are devoted to science have a right to call upon not only men of science, but Englishmen in general, to acknowledge and to pay the debt which we owe to Faraday. Let us think what will be the feelings of a future generation who will look back to him as we look back to Newton. His discoveries of the grand secrets of nature have added to our stores of wealth and ministered to our comforts, and hereafter there will arise the feeling that we have not done as much as we ought for one who has done much for us. He then urged that Faraday and the Royal Institution were standing proofs of the results which could arise out of the voluntary system as opposed to State establishments. Faraday served a voluntary body—a "joint-stock company founded for the purpose of diffusing intellectual pleasure," and this body whom he served gave him a home in which he might carry out his experiments in the field of science. Late in life had come a public recognition of his services in the shape of a pension and a house at Hampton Court—the latter a free gift for life from his Sovereign. He observed that, as the introduction of the electric telegraph and gas had added to the conveniences and comforts of life, and had helped to diminish crime, the discoverers of such secrets of nature at the very least deserved some reward at the hands of those to whom they ministered—if not from the nation in its collective capacity, at least from its individual members; and he concluded his speech by remarking that if any member of either House of Parliament should chance to be present there, he ought to take note of the right relations of the nation to men of science.

The resolution was seconded in a few brief but telling sentences by Dr. Lyon Playfair, M.P.

The three resolutions were severally put to the meeting by his Royal Highness, and declared to be carried unanimously.

A vote of thanks to the Prince for his kindness in presiding over the meeting and for his conduct in the chair was proposed by Sir Henry Holland and seconded by Professor Tyndall, who spoke with great feeling of the loss which both himself and the nation had sustained in the death of Faraday, and alluded to the fact that on that occasion the Prince had been among the first to write to condole with his widow. The motion was carried with great applause.

Dr. Bence Jones then read a letter from Sir John Herschell, excusing his absence on the ground of illness; it ran as follows:—

"I grieve to say that I can only be present in spirit at the meeting of next Monday, the state of my health being such as to preclude my leaving home for many months, most anxious though I should naturally be to show every possible reverence and honour to the memory of such a man as Faraday, whom I have always regarded as the 'blameless prophet' of British science—so clear and far-reaching was he in his views, so indefatigable in their pursuit, so single in his objects, so blameless in his life, so genuine, candid, and unaggressive in all his relations with his brother *savans*."

The Prince briefly acknowledged the vote of thanks, and assured the meeting that he should be proud to lend his aid to the cause which they had met to promote, and it was announced that subscriptions to the "Faraday Memorial Fund" might be paid in at the Bank of England, Western Branch, Burlington-gardens; the London and Westminster Bank, St. James's-square; to Mr. William Hughes, at the Royal Institution, Albemarle Street; or to any members of the committee.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of every chemical paper in the world, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers on a level with the latest advances of science.*

Annales des Mines, vol. 14, sixth series, No. 6.

The greater portion of this valuable periodical is filled with information of use only to the officials and officers of the

Corps Impérial des Ingénieurs des Mines. We meet, however, with a large number of results of analyses of waters, among which is one, very recently made, by M. Peligot, of—

The Water of the Grenelle Artesian Well.—The author calls attention to the remarkable fact that this water does not contain any dissolved oxygen, but only nitrogen, the quantity of which amounts to 14 c.c. to the litre of the water at 10° C. The total saline residue to the litre amounts to 0·142 grm.; the percentage composition of this saline matter is:—Carbonate of lime, 40·8; carbonate of magnesia, 11·5; carbonate of potassa, 14·4; carbonate of protoxide of iron, 2·2; sulphate of soda, 11·3; hyposulphite of soda, 6·4; chloride of sodium, 6·4; silica, 7·0. The same author has estimated the quantity, and determined the quality of the gases contained in rain-water fallen and collected in the neighbourhood of Paris; 1 litre of this water gave off 23 c.c. of gas composed, in 100 parts, of 2·4 parts of carbonic acid; the remainder was a mixture of oxygen and nitrogen, in the proportion of 32 parts of the former to 68 of the latter. M. Stoelet has discovered that the water brought up from the coal-pits contains a greasy matter, soluble in ether, and no doubt derived from the coal; from his observations at and about collieries, he draws the conclusion that this greasy or fatty matter makes the water unsuitable, and, at times, even dangerous, for the use of steam boilers, since it may cause explosions.

It being impossible to quote all, or even the larger portion, of the results of mineral water analysis contained in the above-named periodical, we conclude this brief notice with—

Analysis of the Water of Villa Salic, near Voghera, Piedmont.—M. Tissandier.—The dry residue for 1 litre weighs 65·532 grms., composed of—Chloride of sodium, 61·544 grms., chloride of calcium, 1·031; iodide of magnesium, 1·338, sulphate of lime, 0·144; carbonate of lime, 0·811; carbonate of magnesia, 0·165; silica, alumina, oxide of iron, and organic matter, 0·499; total, 65·532 grms. This water is remarkable on account of the large quantity of iodine it contains.

This number of the *Annales* contains, moreover, a valuable collection of the results of recently made analyses of minerals and rocks from divers parts of the globe.

Bulletin Mensuel de la Société Chimique de Paris, May, 1869.

This number opens with the *extraits des procès-verbaux des séances*, from which we abstract the following:—

Urea.—M. Bouchardat communicated that he had studied the conditions which accompany the production of urea by the action of ammonia upon chloroxycarbonic acid; besides urea, cyanic amides, melanuric acid, and other substances are formed. Hydrogen, in the nascent state, attacks nitrate of urea, thereby producing divers gases, consisting of hydrogen compounds, nitrogen, and carbonic acid. This reaction may be applied to the quantitative estimation of urea, by weighing the quantity of carbonic acid given off.

Oxysulphide of Carbon.—M. Ladenburg gave an oral account of his researches on oxysulphide of carbon. This substance, first obtained by M. Than, by means of the decomposition of sulphocyanate of potassium with dilute sulphuric acid, is also the product of the action of sulphuretted hydrogen upon cyanic ether, and of the action of heat upon thiacetic acid; it is also formed when sulphide of carbon acts upon urea.

Hydrates of Hydrocyanic Acid.—M. Gautier made a few observations on the question of the existence of well-defined hydrates of hydrocyanic acid. The experiments of MM. Bussy and Buignet, on the contraction of mixtures of water and hydrocyanic acid, led to a maximum contraction, corresponding to a mixture expressed by the formula $2CNH + 3H_2O$; if, M. Gautier says, there do exist hydrates, their fusing point must be constant. In order to test this, the author made several experiments on this subject, with mixtures made up of variable quantities of hydrocyanic acid and water taken in definite proportions; not one of these mixtures had a constant melting point (*point de fusion constant*). From his experiments, the author draws the conclusion that two definite hydrates may be said to exist expressed by the formulæ CNH,H_2O and $CNH,2H_2O$; these, by combining together, produce the hydrate $2CNH,3H_2O$.

Iodide of Silicium.—M. Friedel made a brief communication relating to the iodide of silicium, Si_2I_6, which is formed by the action of silver upon the tetraiodide. The first-mentioned substance is decomposed, by heat, into tetraiodide and diniodide; water decomposes this iodide, first forming an unstable hydrate, $Si_2(OH)_6$, which is soon split up, giving rise to the formation of water and silici-oxalic acid, $Si_2H_2O_4$.

Vapour Density of Perchloride of Phosphorus.—M. Wurtz stated that he had repeated experiments on the vapour density of perchloride of phosphorus; his experiments have been conducted at a lower temperature than 160° C, and he has followed the process of Wanklyn, by causing the vapour of the perchloride to diffuse in a known bulk of air. The results of his (Wurtz's) experiments is that 7·2 expresses the vapour density of the perchloride of phosphorus.

The present number of the *Bulletin* contains the following original papers:—

Theory of the Carbides of Hydrogen.—M. Berthelot.—Too lengthy for abstraction.

Formation of Bromide of Acetylen.—M. Berthelot.—The author relates, somewhat circumstantially, how atmospheric influences effect the ready combination of those substances (bromine and acetylen) when in contact; bright sunlight appears to be an essential, but not an exclusive, condition. Since the absorption of acetylen by bromine does not always take place readily, Berthelot advises that when mixtures of gases containing acetylen have to be analysed, subchloride of copper should be used, when no gases but acetylen, absorbable by that substance, are present; subchloride of copper may also be applied as a qualitative test to ascertain whether or not acetylen, when present in a mixture of gases, is being absorbed by bromine, added to the mixture for that purpose. Fuming sulphuric acid was found always to act well, and its action is unaffected by light, a foggy day, or other atmospheric influence.

New Synthesis of Phenol.—M. Berthelot.—This paper is too abstruse for proper abstraction.

Oxidation of the Carbides of Hydrogen.—M. Berthelot.—The author finds that several carbides of hydrogen can be oxidised directly, and without loss of carbon, by the agency of chromic acid dissolved in a small quantity of water. Pure ethylen, free from vapour of ether, is slowly transformed, at a temperature of 120°C., into aldehyd. Propylen is far more readily oxidised, even at the ordinary temperature of the air, aceton being the result of the oxidation; amylen is very violently acted upon by chromic acid, so that no definite products are readily obtained; acetylen is converted into formic and carbonic acids.

"Formation of Substances Homologous with Benzin by the Reciprocal Action of more simply composed Carbides taken in Free State," by M. Berthelot; "Pyrogenic Formation of the Acetylen of the Benzol Series," by M. Berthelot; "Toluidine and Pseudotoluidine," by M. Berthelot; "Researches on the Constitution of Toluen and the Alkaloids Derived therefrom," by M. Rosenstiehl; "New Mode of Preparing Allylic Alcohol," by MM. Tollens and Henninger; "Bromide of Allyl and the Essential Oil of Mustard," by M. B. Tollens; "Boiling Points of the Allylic Compounds," by M. B. Tollens; "Electrolysis of Tartaric Acid and Tartrates," by M. Edm. Bourgoin. These memoirs, evidently concisely written abstracts of longer papers, embodying an enormous mass of scientific research, cannot be properly abstracted, so as to do justice to the authors and their labours.

The remaining pages of this periodical are filled with abstracts taken from papers published in English, German, and

French scientific journals, and also scientific books; but the contents of these abstracts are known to our readers, and are frequently taken from works published some years ago.

Journal für Gasbeleuchtung, April, 1869.

As may be inferred from its title, this periodical is more especially devoted to the interests of gas lighting; occasionally, however, it contains papers of interest to scientific readers, and when this is the case, as in the present instance, we shall make a brief abstract of such paper.

Influence of Heat upon the Regeneration of Sulphide of Iron.—It is well known that, according to theory, only oxide of iron and sulphur should result from the exposure to air of the oxide of iron applied for the purposes of purifying coal gas; in practice, however, it has been found that peroxide of iron, protoxide of iron, and sulphuric acid are also formed, but in variable quantities. Dr. A. Wagner has instituted a series of experiments, in order to ascertain the influence of heat and moisture upon the regeneration process. One sample of sulphide of iron, prepared by the moist way, was kept for three weeks at nearly 100° C., damp, and exposed to air; another portion was kept cold and damp, and exposed, for the same time as the foregoing, to air; while a third portion, under otherwise the same circumstances as No. 2, was kept dry. The result of these experiments is, that heat favours the production of sulphuric acid, while water or moisture does not exert any influence; that moisture and cold (ordinary temperature) produces less sulphuric acid than dryness and cold, since, in the former instance, the occasional watering with cold water, to keep the mass moist, favours a lowering of temperature which, when no moisture is present, is raised, in consequence of the chemical action; water is, however, absolutely required, in order to re-produce the peroxide of iron, since sample 3 was found to have been only very imperfectly converted into peroxide, more than half of the oxide being found as protoxide. The quantities, as deduced from the experiments, are the following:—Sample 1 (hot and moist)—Upon 1 part of S, 0·319 part of SO_3; and upon 1 part of Fe_2O_3, 0·1 part of FeO. Sample 2 (cold and moist)—Upon 1 part of S, 0·034 part of SO_3; and upon 1 part of Fe_2O_3, 0·151 part of FeO. Sample 3 (cold and dry)—Upon 1 part of S, 0·085 part of SO_3; and upon 1 part of Fe_2O_3, 0·5 part of FeO.

Moniteur Scientifique, No. 298, 1869.

This number does not contain any original articles; a portion of its pages are devoted to the description of the specification of patents, the subject matter of which is already known to our readers. Among the miscellaneous matter we observe the following:—

Improved Preparation of Neutral Acetate of Copper.—Five kilos. of sulphate of copper are ground to a fine powder; this having been done, the powder is placed in a suitable vessel, and 7·5 kilos. of liquid ammonia added thereto. After the solution is effected, 10 kilos. of acetic acid are added, and the vessel containing the copper solution placed on a water-bath; as soon as crystals are observed on the top of the liquid, the latter is strongly stirred, which promotes the formation of crystals. By this process, about 4 kilos. of neutral acetate of copper are obtained from the above quantity of sulphate, while the mother liquor yields some sub-acetate of copper afterwards.

Silicium contained in Aluminium.—It is well known that the aluminium of commerce is always contaminated with silicium and iron; a sample of aluminium recently analysed by Prof. Rammelsberg gave as much as 10·46 per cent of silicium, and another sample even 13·9 per cent. The quantity of iron varies from 2·94 to 7·5 per cent.

Silvering Cast-Iron.—M. Bœttger recommends the use of a bath prepared in the following manner:—15 grms. of nitrate of silver are dissolved in 250 grms. of water, and 30 grms. of cyanide of potassium are added; when the solution is complete, the liquid is poured into 750 grms. of water wherein 15 grms. of common salt have been previously dissolved. The cast-iron intended to be silvered by this solution should, after having been well cleaned, be placed for a few minutes in a bath of nitric acid of 1·2 sp. gr., just previous to being placed in the silvering fluid.

Les Mondes, May 20, 1869.

We only notice the following from this paper:—MM. Wurtz, Bouchardat, Gübler, and Bergeron have been appointed to study the not altogether easy but important question, Whether the addition of alcohol to wine, after its fermentation has entirely ceased, is injurious to the health of the consumer.

The title of the following work, from the eminent *savant's* well-known reputation, will not, we think, be unacceptable to many of our readers:—"L'Unité des Forces Physiques, Essai de Philosophie Naturelle," par le R. P. Secchi, Membre Correspondant de l'Institut de France, Directeur de l'Observatoire de Rome, Officier de la Légion d'Honneur, &c. Edition originale Française, grand 8vo., xx. and 700 pages; 56 woodcuts. Paris, 1869.

May 27, 1869.

This number does not contain any original communications or papers.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 7, April 24, 1869.

This periodical contains the following original papers:—

On the Toluylen Group.—MM Limpricht and Schwanert.—The authors begin this paper with an introduction, wherein they state that the reader of their present paper is referred back to memoirs of theirs published some years ago; next, they give a review of chief combinations of the toluylen group, being a series of some thirty chemical formulæ and names (too many to quote here); and they wind up with theoretical considerations on the relations existing between benzin, benzoin, toluol, benzil, and toluylen.

History of the Aldehyde of Salicyl.—M. L. Henry.—Since salicylic alcohol—

$$C_6H_4 < \begin{matrix} HO \\ CHO, \end{matrix}$$

is an aldehyde, as well as a phenol, the author argues that it must be possible to obtain, from the salicylic alcohol, doubly chloruretted cresol, triply chloruretted toluol, and chloruretted aldehyde of salicyl. The author has succeeded in obtaining these compounds from the salicylic alcohol, and in this paper he describes, at length, the processes applied. Doubly-chloruretted cresol—

$$C_6H < \begin{matrix} HO \\ CHCl_2, \end{matrix}$$

is a solid substance, crystallising in prisms, fusing at 82° C.; its alcoholic solution yields, with chloride of iron, a dark red colour. Triply-chloruretted toluol—

$$C_6H_4 < \begin{matrix} Cl \\ CHCl_2, \end{matrix}$$

is an oily liquid insoluble in water; specific gravity, 1·4; boils at 227° C. Chloruretted aldehyde of salicyl—

$$C_6H_4 < \begin{matrix} Cl \\ CHO, \end{matrix}$$

is a colorless liquid, boiling at 210°.

"Tension of Vapour, and Heat of Volatilisation of Chloride of Ammonium," by Aug. Horstman, and "Observations on the Aromatic Theory," by A. Ladenburg, are both too abstruse for translation, an observation which

equally applies to M. Buff's paper, "On the Doctrine of Affinity," a most erudite essay on a difficult subject. Next follow two papers, by two different authors, on the same subject:—C. Rammelsberg's essay, "On the Formation of Periodates from Iodides, by means of Superoxides;" and J. Phillipp's paper, "On the formation of Periodates." "Contributions to our Knowledge of Methyl-Aldehyde," by A. W. Hoffmann. All these papers, being concisely-written and purposely-condensed abstracts made for this periodical, cannot be further condensed.

Polymeric Cyanobromide.—A. Eghis.—When freshly-prepared cyanobromide is placed in a sealed tube, and exposed therein for from eight to ten hours, to a temperature of from 130° to 140° C., the at first crystalline cyanobromide is converted into an amorphous, yellowish-coloured mass, this colouration being due to free bromine, while, at the same time, at the moment of the unsealing of the tube, cyanogen gas escapes. The author found that, with the product prepared in the manner just briefly described, he could not obtain the results he desired to have; he therefore placed freshly-prepared cyanobromide into anhydrous ether, and digested these substances for some time; he thus obtained a perfectly white amorphous powder, insoluble in benzol and absolute alcohol, and fusing at 300°. By analysis, this substance was proved to be a cyanobromide of the formula Cy_3Br_3, containing 74·89 per cent of bromine.

Zeitschrift für Chemie, von Beilstein, No. 8, 1869.

There are no original articles contained in this number, which is entirely filled with translations, chiefly from French papers of older date, the contents of which have already been recorded in the Chemical News.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, May 24, 1869 (No. 21).

Improvement of the Health of Workpeople, by an Improved System of Ventilation and Better Supply of Fresh Air to the Manufactories.—Illustrated by the good effects obtained at the Weaving Factory of Orival, near Lisieux.—General Morin.—Although, in the strictest sense, the subject matter of this paper does not belong to our department, we briefly notice that, in a factory wherein 400 people are daily employed, it becomes a matter of great importance to see to their health, especially in respect of fresh air. The General having been consulted on this subject by the owner of the factory, the former advised that at least 300 cubic metres per head, per hour, should be allowed for fresh air, provision being made to supply it so as to have a proper degree of moisture, as well as a proper degree of heat; into the minute details of the mode of supply, and carrying off the foul air, we do not enter, as this is a matter very much dependent on local conditions of buildings. The good results are proved by the fact (in this instance) that the yearly outlay for medicines had been reduced from 5,000, to less than so many hundreds of francs; while the consumption of bread had largely increased, as compared with the period previous to the making of the above-named improvements.

Distribution of Heat, and Work of the Induction Apparatus.—M. Le Roux.—This is a physico-mathematical essay, too abstruse for condensation.

Means of Ascertaining the Age of any Writing made with Ink containing an Iron Salt.—M. Carré.—The author states that, as long as writing is not very old, it admits of being copied, when moistened with water only, by means of the well-known copying press; further, that when writing has once attained a certain age, an alteration has taken place in the ink, which prevents the ordinary process of copying being successful; but, in that case, moistening with water acidulated with hydrochloric acid effectually aids the copying process. When, however, writing is some eighty years old, this contrivance also fails to aid the copying process; M. Carré found that writing, made in 1787, could not be reproduced by copying press, even when previously moistened with acidulated water.

Experiments on the Quantity of Mud and Slime carried down by Rivers.—M. Hervé-Mangon.—The author finds that the river Var carries from 9·15 to 36·61 grms. to the litre of water, of mud, amounting in one year, on an average, to 18,000,000 kilos., a quantity sufficient to raise a surface of 5,500 hectares (1 hectare=2·471 acres), 20 centimetres in height. The rivers Marne and Seine carry down far smaller quantities of solid materials.

Second Note on Saturation, Surfusion, and Solution.—M. Dubrunfaut.—This is an abstract too concisely written and too long to admit of further condensation.

New Source of the First Terms of Acids belonging to the Fatty Acid Series, and especially on Propionic Acid.—M. Barré.—We hope to return to this paper, and give it in full, at a future time.

Climate of the Isthmus of Suez.—Referring to this subject, M. Le Verrier read an abstract of a letter from Prof. Buijs-Ballot, the Director of the Royal Netherlands Meteorological Institute at Utrecht, wherein that gentleman states that the draining of the Haarlem lake, in Holland, a surface of 19,000 hectares, has had the effect of increasing the average summer temperature of that locality, and adjacent country, by $\frac{1}{2}$°, and of decreasing the average winter temperature, also, by $\frac{1}{2}$° C.

Cosmos, 22nd livraison, May 29, 1869.

The present number of this periodical does not contain anything fit for abstraction for these columns, though, as usual, the periodical is very cosmopolitan and entertaining to general scientific readers.

Annalen der Chemie und Pharmacie, vi., Supplementband, Heft 3, 1868.

As usual this supplement appears rather late in the present year. It contains the following original essays:—

Combinations of Phosphorus.—M. H. Wichelhaus.—The tendency of this essay, for it is that rather than a paper, may be inferred from the title and introduction, wherein the author says, "It is my aim to prove that it is unnecessary to assume anything else for phosphorus than triatomicity." The author, before entering upon his subject, discusses the word and meaning of quantivalence, and next writes an essay, filling some thirty closely-printed octavo pages, too concisely constructed for further abstraction.

"Isomerism of Bicarbonate of Ethylen and Ethyliden," by M. H. Wichelhaus.—"Development of Heat of Chemical Reactions, as dependent on the Change of the Number of the Molecules of Substances," by Dr. A. Naumann.—"Vapour Tension of Formiate of Ethyl and Acetate of Methyl," by M. C. W. Dittmar.—"Relation existing between the Chemical Composition of Arable Soil, and its Property of yielding a Good Harvest," by M. Schultze.—"Ammonium-Amalgam," by M. Laudolt.—"Isomeric Derivatives of Allyl and Propylen," by M. Alphonso Oppenheim.—"New Method of Formation of Resorcin," by MM. Oppenheim and Vogt.

Journal für Praktische Chemie, No. 4, 1869.

This periodical contains the following original papers:—

On Patellaric Acid, a New Lichen Acid, and its Existence in the Parmelia scruposa.—M. H. Weigelt.—The author has written a lengthy essay on this subject. Patellaric acid is a solid, exhibiting crystalline form and snow-white colour; its taste is exceedingly bitter; it is soluble in water, alcohol, and ether; and these solutions

[English Edition, Vol. XIX., No. 496, pages 274, 275.]

redden blue litmus paper. The percentage composition of this acid is:—C, 53·1; H, 5·2; O, 41·66. Space forbids us to quote any more from this paper, which contains the records of a long series of researches, not only on this acid, but on lichens generally, and the *Parmelia scruposa* especially.

Methintrisulphonic Acid.—M. Theilkuhl.—This acid is obtained when methyloxysulphate of lime is treated with a large excess of fuming sulphuric acid. The lime-salt of his new acid has the following percentage composition:—C, 3·62; H, 0·91; S, 29·00; Ca, 18·13; O, 48·34. The rmula is:—

$$(C_2H)\left[\begin{matrix}S_2O_4\\S_2O_4\\S_2O_4\end{matrix}\right]O_6Ca_3+2H.$$

The author has also studied the baryta, potassa, and lead salts of this acid.

Amylendisulphinic Acid.—Dr. Ilse obtained this substance when he made sulphate of chloride of carbon, $C_2Cl_2(S_2O_4)Cl$, and zinc-ethyl act upon each other. The above-named acid has the following formula:—

$$C_2\left\{\begin{matrix}C_4H_5\left[\begin{matrix}S_2O_2\\S_2O_2\end{matrix}\right]O.H.\\C_4H_5\left[\begin{matrix}S_2O_2\\S_2O_2\end{matrix}\right]O.H.\end{matrix}\right.$$

The baryta salt of this acid is a crystaline solid mass, not readily decomposed spontaneously, of the following composition:—

$$C_{10}H_{10}\left[\begin{matrix}S_2O_2\\S_2O_2\end{matrix}\right]O_2.Ba_2+4H$$

It is soluble in water, difficultly soluble in alcohol.

"Researches on the Influence which the Presence or Absence of Water Exerts in regard to the Vitality of the Yeast, or Ferment Cells."—Dr. J. Wiesner.

Ethylenchloride of Iron and Peruvian Balsam.—M. J. Kachler.—Ethylenchloride of iron, $C_2H_4.Fe_2Cl_3$, is formed when a solution of chloride of iron in ether is submitted to a high temperature in sealed glass tubes; it is a solid crystalline substance. As regards Peruvian balsam, the author states that it yields an excellent source of supply of pure benzilic alcohol. From 100 parts, by weight, of the balsam, he obtained 20 parts of benzilic alcohol, 46 parts of crude cinnamic acid, and 32 parts of resin, which, on being oxidised with potassa, yields benzoic and protocatechucic acids.

System of Elements, according to their Atomic Weights and Chemical Functions.—M. D. Mendeleeff.

Moniteur Scientifique, No. 299, June 1, 1869.

This periodical contains the following original papers:—

Molecular State of Bodies.—M. Persoz.—This paper is a continuation of a series already published on this subject in the above-named periodical, but far too lengthy and abstruse for abstraction.

History of Urea.—M. Bouchardat.—This is a very valuable essay, but too lengthy and too much condensed already to be fit for this portion of our paper. We may, perhaps, afterwards return to this subject.

M. Margueritte's Process of Sugar Extraction from Molasses.—The leading portion of this lengthy paper is known to our readers; it was published some time since.

Chemisches Centralblatt, No. 19, May 12, 1869.

This periodical contains an original paper—

On the Sulpho-Acids of the Isomeric Hydrocarbons, C_9H_{12}.—M. O. Jacobsen.—Cumolsulphuric acid, $C_6H_3(C_3H_7)SO_3$. The cumol was obtained from cuminic acid, by distillation with five parts of quick-lime. (Boiling point of cumol, 149°—151° C.) It was dissolved in a mixture of equal parts of fuming and ordinary sulphuric acid, next treated with water and carbonate of baryta, and the cumolsulphate of baryta purified by crystallisation. Free cumolsulphuric acid is a solid substance, very soluble in water and alcohol, and is decomposed by heat without previously fusing. The author studied the potassa, ammonia, lime, strontia, baryta, zinc, copper, and other salts of this acid. The baryta salt belongs to the more stable of these substances.—Isocumol-sulphuric acid, $C_6H_3(CH_3)3SO_3$. This acid, in a free state, is likewise a solid substance, deliquescent, and readily soluble in water and alcohol; it fuses, but becomes at the same time decomposed. It forms crystallisable salts with bases.—Mesitylen-sulphuric acid, $C_6H_3(CH_3)3SO_3$, is also a solid substance, crystallising in six-sided prisms, not deliquescent, readily soluble in alcohol and water, fuses at 100° C., and forms salts with bases, most of which may be obtained in regular crystalline form.—Ethyltoluol-sulphuric acid, $C_6H_4(CH_3)(C_2H_5)SO_3$. Only the baryta and potassa salt of this acid were obtained.—The sulpho-acid of phoron-cumol is a solid substance, readily soluble in water and alcohol; the baryta salt is sparingly soluble in water, and less soluble even in alcohol.

On Ethyldimethylcarbinol.—M. A. Popoff.—This substance—

$$C\left\{\begin{matrix}(CH_3)_2\\C_2H_5\\H\end{matrix}\right\}O,$$

is a fluid boiling between 98·5° and 102° C., and does not freeze at —17° C. Its percentage composition is—C, 68·18; H, 13·62. On being oxidised with chromic acid, it yields acetic acid only.

Bayerisches Industrie und Gewerbeblatt, No. 2, 1869.

This periodical contains chiefly original papers and communications relating to machinery and mechanical engineering; the only original chemical paper is—

Colouring Matter of Wafers.—Dr. Furtenbach.—Although wafers are at the present day far less commonly used for sealing letters than was the case before the introduction of the machine-made gummed envelopes, the researches on this subject are not without interest. The manufacture of wafers is largely carried on at Nurenberg and Munich, and other towns of Germany, and the samples submitted to research were made in the two places just named. Small bright-red coloured wafers left, on incineration, an ash, consisting of oxide of lead, sulphate of baryta, and some sulphate of lead; another sample of wafers, of very bright red colour, was found to be free from sulphate of baryta, and the lead, having been quantitatively estimated, was found to amount to 46·9 per cent of red lead. White wafers were coloured with sulphate of baryta—no white-lead was found; blue wafers are coloured, partly with ultramarine, and partly with Prussian blue, but contained, in all instances, besides these substances, sulphate of baryta, and, in some cases, some white-lead; pink-coloured wafers contain carmine lake, alumina being found in the ash; brown-coloured wafers are tinged with iron ochre; violet wafers were found to be coloured with some violet lac-dye, containing alumina; black wafers are coloured partly with lamp black, and also with harmalin black, which, on incineration, left oxide of iron; green coloured wafers are coloured with so-called green cinnabar (chromate of lead and Berlin blue, mixed), also with poisonous copper and arsenical compounds; buff-coloured wafers are coloured with a mixture of oxide of lead, sulphate of baryta, and some oxide of iron.

Journal de Pharmacie et de Chimie, No. 5, May, 1869.

This paper contains the following original essays and papers:—

Formation and Decomposition of Disulphide of Carbon.—M. Berthelot.—Too long and too abstruse for abstraction.

Action of Ammonia upon Phosphorus.—M. Commaille.—The contents of this paper have been already given in an abridged form.

Influence of Pressure upon Chemical Phenomena.—M. Cailletet.—Too long for condensation.

Mineral Chalybeate Water from the Departement de Maine et Loire.—M. Audouard.—Of local interest only.

The remainder of this number of this periodical is filled with abstracts from the *Comptes Rendus* and other papers already noticed by us.

Journal für Praktische Chemie, No. 5, 1869.

This periodical contains, in the first place, three papers, by the late Professor Schönbein, on the following subjects:—

1. Peroxide of Hydrogen as a Medium for Recognising the Ferment-like Properties of Organic Matter.

2. Peculiar Activity of One-Half of the Oxygen Contained in Oxide of Copper, and the Dependence thereupon of a Highly Delicate Reagent for Hydrocyanic Acid and Cyanides.

3. Existence of Peroxide of Hydrogen in the Atmosphere.

We regret that the above essays, though highly interesting, are too long for abstraction; perhaps we may, at a future day, give abbreviated translations of some of them.

On Hydrocarbons.—M. Fritzsche.

On Benzol.—M. Rochleder.

On Catechin and Catechutannin.—M. Rochleder.

Behaviour of Narcein towards Iodine.—M. Stein.—The author has found that narcein is coloured blue by iodine, but only when the alkaloid is in a solid state; for as soon as the crystals of narcein become dissolved, the colouration disappears. None of the other alkaloids of opium behave in the same manner with iodine.

Analysis of an Alloy found at Pompeii.—M. Milan Nevole.—Specific gravity of alloy, at 13° C., 6·66. It contained, in 100 parts:—Silica, 0·08; lead, 1·12: copper, 55·04; iron, 29·56; antimony, 3·53; zinc, 10·67.

Decomposition of Disulphide of Carbon by Heat.—M. W. Stein.—The author states that the vapour of perfectly pure disulphide of carbon, prepared on purpose for this experiment, was not decomposed when passed through a porcelain tube kept red hot by a Bunsen gas burner; but, on repeating the experiment, and increasing the heat, by the application of a strong coke and charcoal fire, the inner space of the tube having been filled with broken porcelain, it was found to be lined with a deposit of carbon, owing to the decomposition of the sulphide, while sulphur was collected in a receiver.

Isocitric Acid.—M. Rochleder.—This acid is formed when citric acid in aqueous solution is treated with sodium amalgam, care being taken to keep up an acid reaction of the liquid by the addition of dilute sulphuric acid. The isocitric acid may be obtained pure by a rather circuitous process, and then exhibits a crystalline mass, which has not yet been further investigated; neither have any of the salts it forms been studied.

Polytechnisches Journal von Dingler, second April number, 1869.

This periodical, though chiefly bearing upon mechanical science, occasionally contains original communications which are interesting to our readers; from the present number we only abstract:—

Very Durable Cement for Iron and Stone.—M. Pollack, of Bautzen, Saxony, states that, for a period of several years, he has used, as a cement to fasten stone to stone, and iron to iron, a paste made of pure oxide of lead, litharge, and glycerine in concentrated state. This mixture hardens rapidly, is insoluble in acids (unless quite concentrated), and is not affected by heat. M. Pollack has used it to fasten the different portions of a fly-wheel with great success; while, when placed between stones, and once hardened, it is easier to break the stone than the joint.

First May number, 1869.

The greater number of the papers of the present number relate to mechanical science; we notice briefly:—

Diaphonometer to Determine the Transparency of Different Kinds of Glass.—M. Jicinsky.—Without the engravings, it is impossible to make this instrument understood, but, from what is said about it, it is no doubt a useful instrument, especially as the author has proved that the diaphanicity of divers kinds of glass is not dependent so much on its chemical composition, as on certain physical properties due to the heat applied in making it.

Improvement of Acid Waters often Pumped up from Coal-pits and Mines.—Dr. Willigk.—The author had an opportunity to analyse a water pumped up from a coal-pit in Bohemia. This water, it appears, was very acid, from acid sulphates and some free sulphuric acid present therein, consequently attacking and corroding the pumping gear and machinery, and seriously affecting the steam boiler wherein it had to be used. No other feed-water being on the spot, the author advised, and with good success, that the water should, previous to use, be filtered over witherite, carbonate of baryta, which happened to be abundantly present in that locality.

Analysis of a Cement Marl.—Dr. Lindenmeyer.—In 100 parts:—Lime, 36·84; carbonic acid, 28·50; silica, 23·24; alumina, 4·30; peroxide of iron, 1·14; magnesia, 0·96; potassa, 1·48; water, 2·45. Of this quantity, 29·16 per cent was insoluble in hydrochloric acid.

Volumetrical Estimation of Sulphuric Acid.—Dr. A. Clemm.—After reviewing the methods of R. Wildenstein and Carl Mohr, applied for this purpose, the author describes his mode of operating at length. Briefly stated, his method is the following:—The solution to be experimented upon is coloured with litmus, and very carefully neutralised; a solution of chloride of barium of known strength is added in excess, and all the sulphuric acid thereby precipitated. Next, a titrated solution of carbonate of soda is added, in order to precipitate the excess of baryta; and next, again, the excess of soda solution used is estimated, volumetrically, by means of a titrated dilute sulphuric acid. During these operations, no salt is formed which can injure the colour of the litmus. In case salts might be present in the original solution, the bases of which could be precipitated by carbonate of soda, that precipitation is performed previous to the addition of soda. The filtrate, which contains the sulphuric acid combined with soda, is neutralised, and again volumetrically titrated. The solutions required for this experiment are:—A solution of chloride of barium, containing 52 grms. to the litre of water; a solution of carbonate of soda, containing 26·5 grms. of this salt to the litre of water; a solution of sulphuric acid, containing 20 grms. of strong sulphuric acid to the litre of water. These solutions agree among each other, drop for drop. The advantage claimed for this method is the non-necessity of having to wash out the sulphate and carbonate of baryta, and also the advantage that titration does not take place in a fluid rendered turbid by therein-suspended sulphate of baryta, which always tends to render the observation of colouration of litmus more difficult.

Experiments on the Direct Decomposition of Sulphide of Calcium as met with in Soda Waste by means of Chloride of Manganese.—Dr. Richter.—The author has instituted experiments with the view to obtain, directly, the sulphur in such a state as to render its

extraction, by means of sulphide of carbon, an easy matter. Although he has not succeeded quite so well as he desired, he says he hopes his experiments will be repeated by others on a larger scale.

Cryolite Glass, or so-called Hot-Cast Porcelain.—M. Benrath.—The specific gravity of a sample obtained by the author, director of the Imperial Russian Plate-Glass Works at Dorpat, from the American Hot-Cast Porcelain Company, was found to be 2·471. Composition, in 100 parts:—Silica, 67·07; alumina, 10·99; peroxide of iron, 1·02; protoxide of manganese, 1·09; lime, traces; soda, 19·38.

Annalen der Physik und Chemie, von J. C. Poggendorff, No. 3, May 15, 1869.

This periodical contains the following original essays, chiefly relating to mathematico-physical subjects, and hence too abstruse for abstraction:—

Construction of Galvanometers to be applied when Electric Discharges take place, and on the Way Followed by Electric Co-Currents (Nebenstrome).—M. E. Edlund.

Compounds of Tantalum and Niobium.—M. Rammelsberg. This is the concluding portion of a lengthy essay on this subject.

Reproduction of Siemens's Unit of Resistance.—M. von Dehms.

Mineralogical Miscellany.—M. von Rath.—*Angles of the Vivianite System.—Chemical Formula of Silicate of Bismuth.* Eulytin contains, in 100 parts:—Oxide of bismuth, 69·38; silica, 22·23; phosphoric acid, 3·31; peroxide of iron, 2·40; oxide of manganese, 0·30; hydrofluoric acid and water, 1·01; total, 98·63 The specific gravity of this mineral, at 17° C., is 6·106; formula, according to this author—

$$6BiO_3Si_2O_3 + \left\{ \begin{matrix} BiO_3 \\ Fe_2O_3 \end{matrix} \right\} PO_5 + BiFl.$$

Crystalline Form of Atelestite.—Labradorite from Närödal, near Gudvangen.—Boulangerite from the Argentiferous Sand near Mayen.—This mineral is made up according to the formula $3PbS,Sb_2S_3$, and contains, in 100 parts:—Sulphur, 18·21; antimony, 22·83; lead, 58·96.—*New Crystalline Alloy of Zinc and Calcium.* This alloy contains, in 100 parts:—Zinc, 95·13; calcium, 4·87. Formula, $Zn_{12}Ca$; crystalline form, quadratoctahedron; specific gravity, 6·3726; when in contact with water, hydrogen is at once disengaged by this alloy.

Collections of Meteorites.—M. Buchner.

New Sulpho-Salts.—M. R. Schneider.—Sulphide of potassium and iron, $K_2Fe_2S_4$, in 100 parts:—Potassium, 24·59; iron, 35·19; sulphur, 40·22. Sulphide of potassium and bismuth. $K_2Bi_2S_4$, in 100 parts:—Potassium, 12·57; bismuth, 66·85; sulphur, 20·58.

Galvanic Relation of Palladium.—M. Poggendorff.

Simple Expressions for the General Fundamental Principles of Electric Action.—M Weber.—A mathematical essay.

Galvanic Resistance of Liquids.—M. Paalzow.

Mineral met with in the Baryta-Bearing Gangue of Wittich, in the Duchy of Baden.—M. Petersen.—Analysis of *Wittichenite.* Specific gravity, 4·45. It contains, in 100 parts:—Sulphur, 20·30; arsenic, 0·79; antimony, 0·41; bismuth, 41·13; iron, 0·35; copper, 36·76; silver, 0·15; zinc, 0·13.—*Epigenite.* In 100 parts:—Sulphur, 31·57; arsenic, 12·09; bismuth, 2 12; iron, 13·43; copper, 40·32; traces only of silver and zinc.—*Magnetic Pyrites*, in hornblende.—In 100 parts:—Sulphur, 39·93; arsenic, 0·15; lead, 0·10; copper, 0·36; iron, 58·31; nickel and cobalt, 0·63; with traces of titanium, manganese, bismuth, and minute traces of silver.

Specific Gravity of Basaltic Lava.—Dr. A. von Lasaulx.—It appears that this material varies in specific gravity from 1·93 to 2·79. Eight different samples were operated upon, all of which had been previously reduced to a finely divided powder.

Pharmaceutische Zeitschrift für Russland, March and April, 1869.

We take these two numbers together, since the leading original paper contained therein is carried through both these numbers. The paper is an essay, bearing the title—

Glycerine: its History, Manufacture, Occurrence, Estimation of Purity, and Various Applications.—J. W. Klever.—Glycerine is met with in some natural oils and fats, also in the products of the vinous fermentation of sugar; hence it is found in wine in small quantity. It does not occur in fats as such by itself; these substances are to be considered rather as ethers. 100 parts of glycerine dissolve of—Arsenious acid, 20 parts; benzoic acid, 20 parts; oxalic acid, 15 parts; bicyanide of mercury, 27 parts; corrosive sublimate, 7·50 parts; alum, 40 parts; arseniate of potassa, 50 parts; sulphur, 0·10 parts; strychnia, 0·25 parts; morphia, 0·45 parts; acetate of morphia, 20·0 parts. The following substances are insoluble in glycerine:—Ether, benzol, camphor, sulphide of carbon, chloroform, the bromide and iodide of mercury, calomel, fatty acids, fatty and ethereal oils. Glycerine, is decomposed by chromic acid, bichromate of potassa, and permanganate of potassa.

On the Microscope, and the Discoveries made by it.—M. O. Löwenthal. This paper contains a short history of the discoveries made by this useful optical instrument, from Antony van Leeuwenhoek's time down to the present age.

Testing Chloroform for the Presence of Alcohol and Ether.—The chloroform should be first treated with fused chloride of calcium, to eliminate any water, next some iodine should be added. If the chloroform is free from either alcohol or ether, the colour produced by the solution of the iodine is bright red; but when either alcohol or ether are present, the colour of the solution is brown. In order to distinguish between alcohol and ether, a small piece of a crystal of fuchsin is added to the chloroform in question; when the slightest trace of alcohol is present, a deep red solution will ensue. Perfectly pure chloroform yields, with fuchsin, a solution which is only slightly pinkish tinged.

Salt Deposit near Berlin.—M. Jahn.—It appears that there has been discovered near Berlin, at Sperenberg, a rock salt deposit, which in some localities has a thickness of 669 feet. The locality where this important discovery has been made is within eight miles from the capital city of Prussia, and, from borings instituted, it appears, in every respect, a highly valuable mineral deposit.

Non-Identity of Caffeine and Theine.—M. Hager observes that, although elementary chemical analysis of these substances yields results which would conclusively prove the identity of these two substances, yet the author found that the physiological effect, after partaking of a dose of 0·25 grm. of both substances, in chemically pure state, and prepared by himself, is by no means the same. The human organism is imbued with testing powers, compared with which chemical reagents are of little delicacy.

On the Ground Nut, Arachis Hypogœa.—M. F. A. Flückiger.—This is a monograph on the subject, and includes the origin, discovery, occurrence, and commercial history of the fruit of a plant belonging to the natural order of the *Leguminosæ.* The fruit is known, in English language, as ground-nut, earth-nut, pea-nut, and manilla-nut; in French as *arachide* or *pistache de terre.* The plant which yields this fruit is a native of tropical and sub-tropical regions, and belongs especially to Africa. The average weight of the seeds contained in the fruit and bearers of the oil is 0·5 grm.; they yield from 38 to 50 per cent of oil, which consists of

a mixture of glycerine compounds and three different fatty acids—arachinic acid, $C_{40}H_{40}O_4$, fusing at 75° C.; hypogœic acid, $C_{32}H_{30}O_4$, fusing at 35° C.; and palmitinic acid, $C_{32}H_{32}O_4$, fusing at 62° C. The seeds contain 28·85 per cent of protein compounds, 13·87 per cent of woody fibre, and 7.16 per cent of gum and sugar.

Sensitiveness of Divers Methods for the Detection of Arsenic.—M. Frank.—Marsh's apparatus admits of detecting 0·0003 milligramme AsO_3, dissolved in 150,000,000 of its weight of liquid; the method of Von Babo and Fresenuis admits of detecting 0·002 milligramme AsO_3; Reinsch's method, by means of copper, detects 0·001 milligramme AsO_3, in 5,000,000 as much liquid; Rieckher's method, by means of ammoniacal nitrate of silver solution, detects 0·002 milligramme in 3,000,000 parts of liquid.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 8, May 8, 1869.

We notice, in the brief report of the general meeting of the 26th of April last, under the presidency of Professor A. W. Hofmann, that the committee of this Society had arranged and approved of the proposal of M. Scheibler, that a photographic album be made to contain the photographic portraits of the members of the *Gesellschaft*, taken in the well-known card size, and each photograph to bear, moreover, the autograph of the member it represents. At the ordinary meeting of the Society, held on the same day, the following papers were read:—

Simple Method for Determining the Percentage of Water contained in Various Kinds of Starch.—M. C. Scheibler.—The author states that he had been requested by a number of starch and glucose manufacturers to try to find a readily-executable, yet reliable method of determining the quantity of water contained in starch, especially in its green, or raw state. M. Scheibler further says, that it occurred to him that, since starch is insoluble in alcohol, and only contains very slight traces of fatty matter, the object to be obtained might be readily attained by determining the change of the specific gravity alcohol suffers after having been for a length of time in contact with wet starch. In order to test this point practically, some preliminary experiments were first made with starch and alcohol of 90° Tralles (equal to 0·8339 specific gravity at 12 4-9ths degrees R.), and afterwards the following mode of testing was devised:—100 c.c. of the alcohol, weighing 83·4 grms., were placed in a glass-stoppered bottle, and thereto was added 41·7 grms. of divers samples of starch, in separate samples, of which the quantity of water therein contained had been previously ascertained with great accuracy. These samples were left in contact with the alcohol for one hour, care being taken frequently to shake the bottle. After that lapse of time, the alcohol was separated from the starch by filtration, and its specific gravity accurately determined. While experimenting, the author observed that, when the starch contains less than 11·4 per cent of water, instead of yielding up water to alcohol of the above-named strength, it withdrew water from that alcohol. The lengthy paper contains several tabulated forms, and is, on the whole, intended especially to aid starch and glucose makers in their business, and the experiments refer to so-called green starch.

Essay on the Affinity in Solutions of Perchloride of Iron, without Change of the State of Aggregation.—M. A. Müller.—The author says, in the introduction to his paper:—Only when the intensity of a coloured solution decreases, by dilution, in the inverse ratio of the increase of bulk, are we entitled to assume that the molecules of the colouring material are simply mechanically put asunder, and not also chemically modified; when, however, the intensity of colour is affected, in a more or less degree, in a different manner, by becoming more dilute, we are almost forced to assume a chemical change. The author next states that, from experiments made by him, and with solutions of chloride of iron and other coloured metallic chlorides, platinum chloride being preferred, he has found that the intensity of the colour of the solution really depends—1st, on the nature of the diluent; 2nd, on the temperature of the solution; and, 3rd, on the age of the solution—*i.e.*, whether recently prepared or not. As diluents, have been applied—water, hydrochloric acid, solution of chloride of ammonium, and solution of chloride of sodium. The experiments made are described at great length. It appears that the addition of hydrochloric acid, chloride of ammonium, and chloride of sodium have the effect of increasing the intensity of colour of a solution of chloride of iron, even after it has been largely diluted with water; increase of temperature has the same effect.

Varying Behaviour of Iodine towards Sulphuretted Hydrogen under Different Condtions, and the Causes thereof.—M. Naumann.—When iodine is dissolved in perfectly anhydrous sulphide of carbon, and dry sulphuretted hydrogen is passed into that solution, no action whatever takes place. Water, as well as an increase of temperature, are required for the formation of hydriodic acid and the separation of sulphur. The author has gone at great length in studying both the thermic and hydric conditions, which are called into play when the two substances alluded to react upon each other; and, in the second part of his paper, discusses—

The Preparation of an Aqueous Solution of Hydriodic Acid.—Several experiments have been made on this subject, and, as result thereof, the author recommends that, first, a concentrated solution of iodine in pure sulphide of carbon be made; this solution to be next diluted with more of the latter fluid, and then only water to be added, previous to the passing of sulphuretted hydrogen gas into the solution.

Essential Oil of Balsam of Peru.—M. Kraut.—The author found that this oil may be separated, by distillation under reduced pressure, and in an atmosphere of carbonic acid gas, into three different oils:—*a.* Boils at 200° C.; contains 76·20 per cent C, and 6·68 per cent H; and is converted, by chromic acid, into benzoic acid, no carbonic acid becoming disengaged. *b.* Boils at 300°; contains 79·09 per cent C. and 6·00 H; an alcoholic solution of potassa converts this oil into benzoic acid and benzylic alcohol. *c.* Boils at about the boiling point of mercury; contains 81·21 per cent C, and 6·12 H; treated with alcoholic solution of potassa, it is converted into cinnamic acid and benzylic alcohol.

On Cumonitrilamine.—M. E. Czumpelik.—The author describes at great length a series of experiments made by him to prepare this base; the description being too complicated for abstraction, we content ourselves with giving the ultimate result of his labours. Cumonitrilamine is a solid substance, readily crystallising, difficultly soluble in water, but readily so in alcohol and ether; fuses at 45° C.; and boils at 305° C. With acids, salts are formed, and with chloride of platinum a beautifully-crystalline double salt is obtained. The elementary organic analysis of this salt gave, in 100 parts, the following result:—C, 32·74; H, 3·54; N, 7·68; Pt, 26·97; Cl_6, 29·07. These numbers lead to the following formula:—

$$C_{20}H_{26}N_4PtCl_6 = 2\,[C_{10}H_{12}N_2HCl],PtCl_4.$$

The equivalent of this platinum compound is 733.

Base of the Cumin Series, which agrees with Benzylamine.—M. E. Czumpelik.—In this paper, the author tells us how he effected the hydrogenisation of the cumonitrile. While obtaining various intermediate products, he at last got thioamide, an oily liquid, yielding, with hydrochloric acid, a readily crystallisable salt, which combines with chloride of platinum, yielding a crystalline compound, insoluble in water, and soluble in alcohol and ether. This, on being submitted to elementary organic analysis, gave the following results for 100 parts:—C, 33·78; H, 4·15; N, 3·94; Pt, 27·18; Cl_6, 29·95. Formula—

$$C_{20}H_{32}N_2PtCl_6 = 2[C_{10}H_{16}N,HCl]PtCl_4.$$

The equivalent of this platinum compound is 711.

On Trimethylglycerammonium.—M. V. Mayer.—By a complicated set of reactions between substances, the very length of the names of which would occupy too much space, the author succeeded in obtaining a double gold salt of the base named at the head; this salt—

$$AuCl_3N(CH_3)_3C_3H_5(OH)_2Cl,$$

that is to say, the trimethylglycerammonium chloride of chloride of gold exhibits orange-coloured, very lustrous crystals, soluble in water, as well as in absolute alcohol, and fuses at 190° C. The trimethylglycerammonium chloride is a solid substance, crystalline, soluble in water, and decomposed, by boiling with baryta water, into trimethylamine. The author states that his researches on the trimethylglycerammonium, in free state, are not yet quite complete.

On the Means of Entirely Preventing Bumping of Fluids while Boiling.—M. E. Winkelhofer.—The author reviews what has been done by others, and especially by Dr. Pellogio, and next describes, at length, some experiments of his invention, embracing the following fluids:—Methyl-alcohol, sulphuric acid, alcoholic solution of sulphate of protoxide of iron, alcoholic potassa solution, hydrochloric acid, and dilute sulphuric acid, containing some sulphate of lead. His plan, to prevent bumping, is simply an electric current, led into the fluids by means of suitable conducting wires; his contrivances are very ingenious, but certainly too complicated for general use.

Hypotheses respecting the Constitution of Benzol.—This paper cannot be well understood without the diagrams annexed thereto, upon the value of which the reasonings contained in the paper are based.

This number of the *Berichte* concludes with a brief notice, by M. Rammelsberg, correcting some of Mr. Maskelyne's statements in respect of a meteorite and minerals found therein, and the specific gravity of these minerals. Maskeline observed in a meteorite from Breitenbach in Bohemia, occupying a middle place between iron and stone meteorites, a mineral embedded in the iron, of 3·3 sp. gr., and having the composition of enstatite. He found another mineral, which yielded, on analysis, from 97 to 99 per cent of silica, and only having the low sp. gr. of 2·1 to 2·2, and is therefore not quartz; Maskelyne says it is optically doubly axial, and takes it as identical with tridymite, which, however, has a sp. gr. of 2·3, and is optically uni-axial.

Der Papier Fabrikant, No. 5, May, 1869.

This periodical, published in Southern Germany, is not a mere trade circular, but a very well got up paper; and, in the present number, an interesting paper is met with on a subject not quite familiar to scientific, and less so to many practical readers, in this country. We abstract some of the leading features of a valuable paper—

On Ultramarine.—M. Zuber.—The beautiful blue pigment now known as ultramarine, and manufactured in France and Germany on a large scale, has become common by the results of scientific and analytical chemistry. The native ultramarine, also called lazulite, lapis lazuli, and zeolite blue, is a rather rare mineral, of which, in pure state, according to Patrin, Central Asia is the native place. This native mineral consists, in 100 parts, according to Varrentrapp's analysis, of:—Silica, 45·40; alumina, 31·67; soda, 9·09; lime, 3·52; sulphuric acid, 5·89; sulphur, 0·95; iron, 0·52; chlorine, 0·42; water, 0 12. According to Field, the formula for this mineral is—

$$6[3SiO_3.NaO.Al_2O_3],FNaS.$$

The finest specimens of native ultramarine are used as precious stones; and some of it is still used by artists, it being prepared for that purpose, in a peculiar manner, chiefly at Rome and Florence. Artificial ultramarine was first made by a process discovered by M. Guimet, in France, in 1826, but kept secret, and remaining so up to the present day. Although the pigment obtained by artificial means is one of great beauty and permanency, under ordinary conditions it is never made equal to the pigment derived from the native *lapis lazuli*. Notwithstanding a large number of scientific and practical men have studied this subject, the precise answer to the question, whence the blue colour of this substance is derived from, is a perfect mystery; the only fact certainly known is, that a portion of the sodium is combined with the sulphur, to form a certain sulphuret, and that that alkaline sulphuret is chemically combined with a double silicate of alumina and soda. Iron and calcium have been proved to have nothing to do with the cause of the blue colour, and to be simply accidental. In the original paper, from which we condense the results, no less than 10 analyses of samples of artificial ultramarine, made by different analysts, and from different makers, are given. Varrentrapp's results are, for 100 parts, as follows:—Silica, 46·60; alumina, 23·30; soda, 21·46; sulphur, 1·68; potassa, 1·75; iron, 1·06; lime, 0·02; sulphuric acid, 3·08; with traces of chlorine, oxide of iron, oxygen, and an accidental trace of clay. The ingredients required for the manufacture of artificial ultramarine are—sulphur, wood charcoal, sulphate of soda, carbonate of soda, and kaolin; curiously enough, the latter substance is preferred from Cornwall, and fetched thence to be transported abroad, while the manufacture of ultramarine in this country is of little or no importance. The product of ultramarine met with in commerce is rarely, if ever, adulterated, unless it be with the pure sulphates of lime and baryta, to reduce the original deep blue colour to a less dark shade. In order to test the colouring value of a sample of ultramarine, it is usual to weigh off 0·1 grm., and to mix it, in a dry state, with 1 grm. of powdered French chalk, and to compare the tinge obtained with other mixtures of the kind and a standard sample of ultramarine. Besides being largely used in oil painting, ultramarine yields blue printing ink, blue for calico, silk, and woollen tissues; for colouring paper, sugar (it is largely used in sugar refineries to brighten the loaf sugar), fresco and stucco painting, and other purposes. All acids, especially the more concentrated ones, destroy the colour, which, however, stands fire, as well as many other agents. The native ultramarine is not affected by acids unless heat is at the same time applied.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, February, 1869.

None of the papers contained in this periodical bear upon chemical science, or subjects more immediately connected therewith.

Annalen der Chemie und Pharmacie, May, 1869.

This periodical contains the following original essays and papers:—

On Indium.—M. R. E. Meyer.—The author opens his lengthy essay with a review of the labours of others on this subject. He then states that the source whence he extracted indium is the zinc from Freiberg, in Saxony. The preparation of the metal, and its purification, are described at great length, but, since no new method was applied, we need not enter into details on this subject. The various combinations of this metal with iodine, bromine, chlorine, cyanogen, sulphuretted hydrogen, and, next, salts of the oxide, are described. The iodide of indium, InI_2, equivalent 329·6, contains, in 100 parts:—Indium, 22·94; iodine, 77·06. The chloride of Indium, $InCl_2$, equivalent 146·6, contains, in 100 parts:—Indium, 51·57; chlorine, 48·43. A large number of double salts and compounds of the halogens of indium, with similar compounds of other metals forming double halogen compounds, are described in detail; in fact, the essay is an exhaustive monograph on this subject.

On Lactic Acid and β Iodpropionic Acid.—M. Socoloff.—This essay is a review rather of what has been done on this subject by other experimenters, than an ac-

count of the author's own labours. He states that the β iodpropionic acid was prepared by him in the same manner as was done by MM. Beilstein and Moldenhauer. Several salts of this acid were prepared by M. Socoloff, and submitted to organic elementary analysis. The calcium salt yielded, in 100 parts:—Carbon, 33·08; hydrogen, 4·62; calcium, 18·34; the remainder being oxygen. In a tabulated form, the author records the physical properties of the calcium, barium, zinc, and lead salts of the acid submitted to research by him, and of ordinary lactic acid, paralactic acid, and methylglycolic acid. The lengthy essay winds up with a theoretical discussion on mono-acid, bin-acid, and even hepta-acid alcohols.

Researches on the Derivatives of Salicine.—M. Hugo Schiff.—This paper is the first of a series to be continued by the author on this subject, and this portion is headed—I. *Amide of Salicyl Aldehyde.* The author begins by stating that the formula for the aldehyde of salicyl should be written—

$$C_6H_4\begin{cases}OH\\CHO'.\end{cases}$$

Next, the preparation of this aldehyde is described as follows:—Take, from 300 to 400 grms. of salicine, and the Ettling oxidation mixture (nothing is said as to what this mixture consists of); during the time the distillation is going on, water is allowed to drop continuously into the retort, in order thereby to keep up the original degree of concentration of its contents, and to prevent the formation of resin as much as possible. The aldehyde, after having been separated from the water, is saturated with common salt, and mixed with ether; in this manner, about one-third of the weight of the salicine originally taken is obtained as aldehyde. The author next treats of the products of the action of aniline upon salicyl-aldehyde, and then describes, at great length, several complicated combinations, as, for instance, salhydrethylanilide, formula—

$$C_6H_4\begin{cases}OH\\CH.\end{cases}\begin{cases}NC_2H_5.C_6H_5\\NC_2H_5.C_6H_5\end{cases}=C_{23}H_{26}N_2O;$$

ethylsalhydranilide—

$$C_{15}H_{15}NO;$$

and ethylsalhydrethylanilide—

$$C_{25}H_{30}N_2O.$$

Several metallo-compounds are next described—Copper salhydranilide—

$$C_{26}H_{20}CuN_2O_2,$$

containing, in 100 parts:—Carbon, 68·2; hydrogen, 4·6; copper, 13·7.

Derivatives of Propane.—M. Carl Schorlemmer.—Propane, a hydrocarbon, C_3H_8, is described, first, as regards its preparation from isopropyliodide and zinc turnings; next a chloride of propane is prepared, which, on being analysed, yielded results leading to the formula C_3H_7Cl. The author describes several experiments, made with the view to obtain chemically pure products, and ends his paper by promising more accurate and full details on this subject.

On Hydroxylurea.—Drs. Dresler and Stein.—When hydroxylamine and cyanic acid act upon each other, a substance is obtained, the composition of which may be expressed by the formula $N_2CH_4O_2$. The authors state how they proceeded to obtain this substance, in a pure state, by a rather complicated and lengthy process. The hydroxylurea is a solid substance, very soluble in water, sparingly in alcohol, crystallising in needle-shaped crystals; it fuses at 130° C., and is decomposed when that temperature is continued, yielding carbonic acid and ammonia. The substance is readily acted upon by caustic potassa and nitric acid; its solutions, in neutral fluids, reduce solutions of salts of silver to the metallic state.

Comptes Rendus des Séances de l'Académie des Sciences. Monday, May 31, 1869 (No. 22).

We notice, in the first place, an abstract of a memoir—

Decomposition of Chloride of Sodium and Chloride of Potassium by Metallic Iron under the Influence of Moist Air.—M. E. Chevreul.—After having entered upon some historical details, and gone back as far as the year 1779, when Scheele experimented on this subject, he proves, by a simple experiment made before the meeting, that, when chloride of sodium, iron, water, and air are in actual contact, decomposition of the alkaline chloride takes place; further, that this decomposition is not, as has often been stated, an effect of efflorescence, but a double decomposition, according to the well-known law of Berthollet, which, however, was rather too vaguely formulated by its original author.

New Spectrum Observations of the Sun's Atmosphere and Protuberances.—Rev. Father Secchi, S.J.—In the shape of a letter, addressed from Rome, and dated May 21st, the eminent *savant* states:—The spectrum observations of the solar protuberances made by M. Rayet, during the eclipse of the sun, in the month of August last year, have revealed a considerable number of luminous rays, seven of which were especially prominent; only four of this number have afterwards, when no eclipse takes place, been found to exist with certainty—viz., the three principal rays of hydrogen, and the yellow ray in the neighbourhood of sodium. It was highly interesting to try whether, under favourable conditions, these three other rays could be again found. I am happy to be able to state that, during my observations yesterday (May 20th), I have succeeded in seeing these rays with perfectly absolute certainty. The author proceeds to describe the exact locality where he discovered these rays, and gives a diagram to illustrate this portion of his letter; and next describes the nature of these rays at length, illustrated by a diagram. It appears, from this description, that the rays exhibit great brilliancy, and are more remarkable, even than could be expected at first from M. Rayet's former observation. The rays are those of magnesium, hydrogen, and a none-gaseous (as yet undetermined) substance.

Scientific Aerostation.—M. Tissandier states that a balloon, of 10,000 cubic metres (about 354,000 English cubic feet) capacity, and of 2500 square metres surface, has been placed, by M. le Ministre de la Guerre, at the disposal of several scientific men, and that it is intended to have (on June 27th and July 11th ensuing, from the Champs de Mars, Paris) ascents with this balloon, the car of which is capable of carrying with comfort ten people, and, in addition, 1500 kilos weight. Members of the Academy desirous of being of the party are requested to state so. This balloon is formed of four layers of tissue, glued together by means of india-rubber, and is to be filled with hydrogen; and experiments already made have proved that it preserves that gas unaltered for a long time.

On a new Thermo-Electric Battery made with Galena.—MM. Mure and Clamond.—This battery is composed of sixty elements, made up of small bars of galena, 40 m.m. in length by 8 m.m. thick, and bars of thin sheet iron, 55 m.m. in length by 8 m.m. in width, and 0·6 m.m. thickness. These materials have been arranged so as to form a hollow cylinder, which, when it is intended to be used, is to be heated by a peculiarly constructed gas burner. The specimen of this battery exhibited at the meeting had an electro-motive force of 1½ Bunsen element. M. Becquerel read a lengthy paper on the subject of this battery, the result of which is, that thermo-electric batteries, constructed either of metallic alloys, or as in this case, of a metallic sulphide and a metal, are not economical in use, and are too liable to changes brought on by the effects of the heat.

The Law of Mariotte, and on the Liquefaction of Gases in Relation to the State of Dryness of these Gases.—M. Dubrunfaut.—Curiously enough, and in spite of, and against all evidence to the contrary, the author

insists that perfectly pure and dry gases cannot be liquefied by any pressure or any lowering of temperature, however great. He says, the intervention of water is an absolute condition of the condensation of gases to fluids; no wonder that M. Dumas should vehemently protest against a heresy so flagrantly in opposition with experience.

Chemical Constitution of Amylaceous Matter.—M. Musculus —The author has made a series of experiments, in order to prove that the formation of dextrine from starch is only the first step in the process of splitting up which starch undergoes when it is placed in contact with water and diastase at a temperature of from 60° to 75° C., and that the quantity of sugar obtained by this process represents at least two equivalents. The lengthy paper contains the results of a series of experiments, too long and too many to be further quoted here, but the author has to confess that his main object has not been attained.

Researches on the Ethers of Phenol.—M. E. Lippmann.—The author has studied—*Ethylen-diphenol*—

$$\left.\begin{matrix}(C_6H_5)\\C_2H_4\end{matrix}\right\}O_2.$$

Ethylen-diphenolsulphuric Acid.—The lead-salt of this acid crystallises, and is soluble in hot water, but insoluble in cold water. The analysis of the salt, dried at 120° C., gave, in 100 parts—C, 29·49; H, 2·0; Pb, 35·7. Formula—

$$\left.\begin{matrix}C_6H_4SO_3Pb''\\C_6H_4SO_3\\C_3H_4\end{matrix}\right\}O_2.$$

Ethylen-diphenosulphate of Barium.—A crystalline powder, not very soluble in boiling water. Its elementary organic analysis gave, for 100 parts:—C, 33·0; H, 2·3; Ba. 26·9. Tetrabromide of ethylen-diphenol is composed, in 100 parts, of:—C, 31·6; H, 2·0; Br, 60·3. Formula—

$$\left.\begin{matrix}C_6H_3Br_2\\C_6H_3Br_2\\C_2H_4\end{matrix}\right\}O_2.$$

The author states that the preliminary note from M. Burr on this subject, published in the *Zeitschrift für Chemie*, No. 6 (see Chemical News, vol. xix., p. 251), had not come into his possession when he made his experiments.

New and General Method for the Preparation of Nitriles.—M. L. Henry —The author has succeeded in transforming amides into nitriles, by means of pentasulphide of phosphorus, and has especially operated upon acetamide and benzamide, making use of 1 equivalent of the pentasulphide of phosphorus upon 5 equivalents of the amide. The result of the action of the pentasulphide of phosphorus upon acetamide is aceto nitrile, $(C_2H_3)N$; while the result of the action of this material upon benzamide, is cyaphenine, a polymere of benzonitrile, $(C''_7H_5)N$.

Physiological Effects of Stanethyl and Stanmethyl.—MM Jolyet and André Cahours.—The authors describe the preparation of these chemical compounds which may be obtained by means of the perchloride of tin, Sn_2Cl_4, at great length, and then describe the physiological effects, which are those of stupor, inducing narcotism in the very highest degree.

No. 23, June 7, 1869.

We notice, from this periodical, the following memoirs, papers, and communications, omitting those relating to physiology, medicine, mathematics, and mechanical science:—

Synthesis of the so-called Aromatic Acids.—M. Wurtz —The author describes, in the following terms, a new method for the synthesis of the above acids:—When an organic chloride, or bromide, is treated with chloroxycarbonic ether and sodium amalgam, the haloid element is eliminated by the sodium, and replaced by the group $CO_2(C_2H_5)$; if it is, therefore, required to convert a carbide of hydrogen into a higher monocarbon acid of the series, the monochloride or monobromide of that carbide of hydrogen is first prepared, and then heated with chloroxycarbonic ether and sodium amalgam. The author next proceeds to describe some experiments made by him, and the results obtained, at length; starting with bromide of phenyl, C_6H_5Br, and mixing this chloroxycarbonic ether and sodium amalgam, the following formula represents the reaction, resulting in the formation of benzoic ether:—

$$C_9H_6Br+CO\left\{\begin{matrix}O.C_2H_5\\Cl\end{matrix}\right.+Na_2=NaCl+NaBr+C_6H_5.CO_2(C_2H_5).$$

Use of the Spectroscope to Distinguish a Feeble Light, Present with a Stronger Light.—M. Seguin. —The author describes a series of experiments with electric light, and observations thereon with Duboscq's vertical spectroscope. The result and conclusion arrived at is, that the spectroscope serves eminently the purpose of detecting (proved, also, by the other observations made with it of the sun's light and protuberances) a more feeble light present along with a much stronger, and the former of which would be invisible to the naked eye, or by means of other optical instruments.

On Acetochlorhydrine and Octylglycol.—M. de Clermont.—Into 50 grms. of anhydrous acetic acid, strongly cooled, anhydrous hypochlorous acid is passed, until the acetic acid has absorbed 10 grms. of the latter; no stronger solution should be made, as there is danger of explosion. To the mixture of acetate of chlorine and anhydrous acetic acid is added a quantity of 14 grms. of pure octylen, previously mixed with anhydrous acetic acid; acetochlorhydrine is thus formed, which, being held in solution by the acetic acid, is separated therefrom by addition of water. The acetochlorhydrine of octylen is a highly mobile liquid, devoid of colour, of agreeable and aromatic odour, soluble in alcohol, ether, and acetic acid, insoluble in water, burns, when ignited, with a sooty greenish-bordered flame, and boils, without decomposition, at 225° C. The specific gravity of this liquid is, at 0° C., 1·026, and it consists, in 100 parts, of:—C, 58·11; H, 9·20; Cl, 17·19. Density of vapour, 7·12.

Acetic Derivatives of Mannite.—M. E. Grange.—When crystallised mannite is heated, in an open vessel, with strong acetic acid, and boiled, there is left, on cooling, a crystalline mass embedded in a syrupy liquid; the latter is separated by filtration over asbestos, and the dry solid residue washed with strong absolute alcohol, to eliminate the acetic acid. The material, thus purified, is hardly soluble in alcohol, not at all in ether, and very soluble in water and acetic acid. Submitted to analysis, it yields, in 100 parts:—C, 45·42; H, 7·027; O, 47·553; corresponding to the formula $C_{14}H_{26}O_{11}$, equal to $C_{12}H_{23}(C_2H_3O)O_{10}$. The author describes a series of results of experiments of various reactions of divers substances with this compound, but our space does not permit us to enter into details.

We only notice the titles of the two next papers, which are not suitable for abstraction:

Observations on the Phenomena of Supersaturation.—M. Margueritte.

Second Notice on the Theory of Supersaturation and Solution.—M. Lecocq de Boisbaudran.

Salts of Phenetolsulphuric Acid.—MM. Opt and Lippmann.—Phenetol—

$$\left.\begin{matrix}C_6H_5\\C_2H_5\end{matrix}\right\}O,$$

is a liquid, boiling at 168° C. When sulphuric acid is added to it, a pink colour ensues, and, after the mixture has been heated upon a water-bath for about an hour and a half, a crystalline mass is formed; this is dissolved in much water, treated with baryta water, and the excess thereof eliminated with carbonic acid. In this manner, a beautifully crystallising baryta salt of the phenetolsulphuric acid is obtained:

the composition of this salt, in 100 parts, is:—C, 35·62; H, 3·03; Ba, 25·04; H_2O, 11·78. The formula is—

$$C_6H_4So_3C_2H_6O)_2Ba'' + 4H_2O.$$

The authors briefly describe the lead and potassium salts of this acid.

Elimination of the Nitrogen contained in Beet-Roots during the Process of Manufacturing Sugar therefrom.—M. A. Renard.—This paper is chiefly of importance to beet-root sugar-makers.

On the Meteoric Stone fallen from the Sky, on the 22nd of May, 1869, at Cleguerec Departement du Morbihan, France.—M. Limur states that, on the evening of the 22nd of May last, at 9·45 p.m., local time, there was heard at Vannes, the capital town of the department, a heavy report, like that due to the firing of large ordnance, while the sky was at the same time illuminated by a bluish white light, accompanied by sparks somewhat like those of fireworks. The next day the author learned that, at Cleguerec, a meteoric stone had fallen, which had been broken into pieces by the peasantry, and fragments of which, weighing 22 and 16 kilos. had been secured by some parties, who, knowing the value scientific men attach to these extra-terrestrial visitors, will shortly send them to Paris for investigation.

Palladium and Hydrogen.—M. Fevre states that, according to his experiments, the hydrogen in palladium saturated therewith is present as a chemical compound, and not simply in the state of condensed gas. The author also states that the vapour of boiling mercury is as little a conductor of electricity as hydrogen is, and that, therefore, the non-conductibility of hydrogen for electricity cannot be regarded as an objection to its being a metal.

Cosmos, No. 23, June 5, 1869.

The only communication contained in this number suitable for translation to our pages is—

New Marking Ink for Linen.—M. Kuhr recommends the following preparation:—One part of hypophosphite of soda, and two parts of gum arabic, are dissolved in sixteen parts of distilled water. The tissue, linen, or cotton to be marked is thoroughly moistened with this liquid, and then left to dry. After having become well dried, the following liquid, composed of one part of nitrate of silver, and six parts of gum dissolved in six parts of distilled water, is used as marking ink, with a quill-pen. The mixtures here described are stated to yield an indelible and very deep black-coloured ink.

Comptes Rendus des Séances de l'Académie des Sciences, Monday, June 14, 1869 (No. 24).

This periodical is entirely filled with the reports about the prizes and the distribution thereof. The greater part of the speaking at this meeting of the Académie devolved upon the eminent and eloquent speaker who honoured the Chemical Society with his excellent speech on the night of Thursday (June 17) at the Royal Institution in London, M. Dumas; and his eminent *confrère* as Sécretaire Perpetuel, M. Elie de Beaumont, read the eulogium on the late M. Puissant, an excellent geodosist and late member of the Académie. Among the prizes distributed we notice the Jecker prize, which has been granted to M. P. A. Favre for his researches on the heat set free by chemical combination; a sum of 2,000 francs (£80) has been granted to M. A. Gautier for his researches on hydrocyanic acid, the nitriles, and a new class of substances isomeric therewith.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 196, April, 1869.

Omitting the papers on subjects connected with mechanics and engineering, we meet with a report—

On the New Method of Purifying Oils invented by M. Michaud, of Honfleur; the report is from the hand of M. A. Chevalier. After having reviewed the different processes in use from the middle of last century, to render fatty oils, such as rape seed and colza oils, more suitable for use in lamps of a more complicated construction, the author of the report states that M. Michaud's process consists of a defecation of the raw oil by the simultaneous introduction therein of jets of air and thin streams of sulphuric acid, whereby those substances contained in the raw oil, which are injurious to its properties for use in moderator and carcel lamps are coagulated and brought to the surface of the oil as a scum, which can be easily removed; the oil is next washed with water, afterwards heated by steam to 100° C., and lastly filtered through cotton and a layer of clean and pulverised marble, at a temperature of 40° C., yielding an excellent material for use in lamps.

This number also contains a lengthy treatise—

On Electricity and its Application to the Construction of Electrical Apparatus for Medical Use.

And a lengthy treatise—

On the Cultivation of the Mushrooms known as Truffles.—To this paper are added analyses of twenty-four different kinds of soil taken from various parts of France, but it does not, after all, appear that there is distinct relation between any kind of soil and its capability of growing these dainties, which, as appears from this paper, were largely cultivated in France, for the use of the wealthy Romans, at the time Cicero and Horatius lived. Curiously enough, those parts of France—the native country *per excellentiam* of truffles—which produce good wine, do, as a rule, also produce these cryptogamics in excellent condition.

Annales du Génie Civil, No. 5, 1869.

This periodical contains the following short notices concerning matters of interest to our readers, in addition to its valuable papers relating to mechanical science:—

Artificial Ebony.—This material is prepared on the large scale in the following manner:—60 parts of charcoal, obtained from seaweeds, and previously treated with dilute sulphuric acid, and dried, are ground to powder, and mixed with 10 parts of liquid glue, 5 of gutta-percha, and 2½ of caoutchouc, care having been taken to mix the two latter substances with coal-tar oil, and thus to render them gelatinous; next 10 parts of coal tar, 5 of pulverised sulphur, 2 of pulverised alum, and 5 of powdered resin are added, and the mixture heated to 300° F. After having been cooled, a substance is obtained, which in every respect is equal to genuine ebony wood, but is far less expensive, and takes a finer polish.

Vulcanisation of Caoutchouc.—In a great many instances, especially when a superficial vulcanisation only is desired, bisulphide of carbon and chloride of sulphur only are applied. Since the bisulphide is very inflammable as well as very volatile, and is, beside this, injurious to the health of the workmen, it is desirable to desist from its application; instead of it, petroleum is now used, after having been submitted to a peculiar process of refining; it is for that purpose mixed with sulphuric acid, thoroughly stirred, and, after having been left quiet for some time, the supernatant oil is withdrawn by means of a syphon, and placed in distilling apparatus along with some caustic potassa, and submitted to distillation. The refined petroleum thus obtained is, however, a less good solvent for caoutchouc than the bisulphide of carbon, and hence the vulcanisation process may, by the use of petroleum, become less complete and less penetrating than by the use of the bisulphide of carbon.

Manufacture of Phosphorus.—M. Brison proposes to apply for this purpose on the large scale, a furnace not unlike a blast furnace as used for the reduction of iron ore.

Through a kind of throat or mouth, which can be hermetically closed, coke and phosphate of lime, either apatite, coprolites, or any other, are introduced, along with a sufficient quantity of a suitable flux to liquefy the lime of the phosphate and the ashes contained in the coke. A blast-pipe, connected with a blowing engine, introduces a sufficient supply of air to keep the coke, after having been ignited, at a high temperature, while a tube, plunging into a tank, filled with cold water, is intended to carry off the vapors of phosphorus set free by the reducing action of the coke upon the phosphate; the slag is run off in a peculiar manner, somewhat akin to that in use with blast furnaces at iron works, but so as to prevent phosphorus escaping. According to a note by the editor of the paper at the head of this notice, the results obtained with this furnace are very satisfactory.

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Les Mondes, June 3, 1869.

Newly-Invented Gunpowder.—A Bavarian chemist, named M. Hahn, has brought to Paris a proposal to sell his invention of a new kind of gunpowder, which, according to his statements, is so readily prepared, that one workman while engaged for ten hours a day, can mix 200,000 kilos (200 tons) of the materials the powder is to consist of, which are substances readily procurable in any country. This powder, on being ignited, gives off no smoke, and is neither affected by damp nor dryness, and can be safely stored anywhere. We refrain from quoting more about this subject, as we fear *le bon* Père Moigno has been taken in somewhat, as would appear from the statement that this powder, while floating on water, yet explodes in contact therewith, and is not after all affected by damp (*sic*).

Boiling of Sugar.—M. Woestyn.—The only noteworthy point in this rather practical paper, is the observation, made by the author, that, notwithstanding the use of the vacuum pan, by the application of steam of 1, 2, 3, 4, or 5 atmospheres over and above the atmospheric pressure, and corresponding to temperature of 100°, 122°, 134°, 143°, 152° C., an increase of colouration, averaging 2, 4, 8, 12, and 16, is obtained, while, at the same time, research with the *saccharimetre optique* proves analogous quantities of inverted sugar in the product previous to the boiling free therefrom.

Among the books of which receipt is acknowledged we notice an Italian monograph, by M. A. Raffaelle Drago, which bears the title—"*Resumé* of the Theory of the Rev. Father Angelo Secchi, S.J., on the relation existing between the Meteorological Phenomena and the Variations of Terrestrial Magnetism." This book is highly spoken of in the above-named periodical, which contains a lengthy paper, "On the Phosphorescence and Luminosity of Gases under Reduced Pressure," translated from the official Gazette of the Kingdom of Italy; this paper, however, does not contain anything on this subject which is not already known to our readers.

June 10, 1869.

The only communication we briefly notice from this number is:—

Localities of Rock Salt.—Dr. A. Boué.—The author says: The ten or twelve large sites of rock salt at present known belong, in a geological sense, to either secondary or tertiary formations; those of the Devonian and Silurian deposits appear to have been formed by the evaporation of their existing seas, by the action of the heat of the interior of the globe. The saline deposits and beds of gypsum of triassic period are neither due to evaporation nor sublimation, and appear to have been rather formed by saline waters, saturated solutions of salt, from springs, running into then existing seas, and causing such a supersaturation as to bring about a deposit of chlorides and sulphates. The saline springs, salt springs of the cretaceous period, may be the result of fresh water which has become saturated with salt while traversing deeper lying beds thereof, and being afterwards forced up by hydrostatic pressure. It may be said that a continuous diminution of sea-water has been taking, and is yet actually taking place, from the first existence of a sea on our globe, either by chemical action or by infiltration.

NOTICES OF BOOKS.

More Light. A Dream in Science. Wyman and Sons, Great Queen Street, Lincoln's Inn Fields.

In the so-called "scientific world" we find a large number of men who do not work. The reasons why they do not work are not always so obvious as one would imagine. Some, including among them many of our most influential and successful men, do not work simply because they find it unnecessary. Fluent, strong in voice and in nerve; ambitious, and, perhaps, just the least thing in the world intriguing, they find it far more easy to acquire a position in scientific societies by criticising the researches of others than by working themselves. It is men like these who so mercilessly cross-examine the laborious workers who venture to read their papers before scientific bodies. These cross-examinations are, moreover, often carried on in a semi-bantering tone, as if the student had taken a liberty in bringing his results before a body, some of whose most august members found work unnecessary. And how often, in all countries, do we find the mantles of the greatest workers placed on the shoulders of these very men.

On the other hand, a vast number of those we meet in scientific circles do not work, simply because they prefer to dream. As there are people (even in this our day) who buy works on witchcraft and alchemy, not as curiosities, to be laid on the shelf until wanted as illustrations of the history of a past age, but to read them with reverence and faith, so there are men who revel in any darkness that has a savour of mystery. They have an instinctive repugnance of those physical truths which can be demonstrated by an appeal to the balance; as we have said, they prefer to dream; but we must do them the justice to say they generally keep their dreams to themselves. The author of the pamphlet before us is a man of a different stamp; he publishes his dreams, charges one-and-sixpence for them, and fearful that his just rights and property in his dreams will be infringed, he carefully reserves the right of translating them. This is wrong. When a great prophet comes to give us "more light" (and we confess that we need it), he should rather encourage than repress those who would disseminate it.

But, to proceed—It was on a winter's evening, in December, 1866, that our author sat by the fire reading, to relax what he is pleased to term "his mind," which had been for several hours absorbed in "abstruse scientific speculations." The book that he read was George Henry Lewes's "Life of Goethe." As he read his last memorable words, "More light!" and pondered upon their depth of meaning, he fell asleep. What then happened he does not tell us; but a mysterious line of asterisks at once informs us that it was something very awful. Soon there appeared at his right hand a man, "beautiful of countenance." On his brow was a band, on which appeared, in sparkling gems, the name "Oriel," "Light of God;" and in his right hand he held a rod. Our author here pathetically tells us that he "trembled." This was but natural; he probably feared that Oriel was about to lay it on. Oriel, however (who, although a highly rectified spirit, appears to disagree with the stomach or brain of the eminently dyspeptic dreamer), bids him not be afraid, and, good-naturedly taking him by the hand, places him on a "Pinnacle of the Universe."

Oriel then tells him the destiny of the sun, and explains a few other astronomical phenomena, in language which shows distinctly that he has read Herschel's "Astronomy," and that his reading has been for edification. Our author (doubtless because Oriel has laid aside his rod) now not only ceases to "tremble," or to be "afraid," but even summons up courage enough to put a regular poser to Oriel in these

startling words—"What is matter?" Oriel, evidently at a nonplus for the moment, does exactly what we all do under similar circumstances, and, instead of answering the question, proposes another, namely, "What is mind?" If our author had been sharp, here was a capital opportunity for a repartee. He should have answered "It is *no matter*;" but, instead of this, he somewhat feebly gives the views of Newton and Bishop Berkeley. Afterwards, feeling that he is expected to quote some more modern philosopher, he states "matter to be nothing but force, thus depriving it of that grossness generally supposed to belong to it." This, he says, "was the opinion of Faraday, who could not prove it, but yet believed it not impossible."

Poor Oriel, feeling himself unable to oppose the views of Faraday without losing the confidence of our Dreamer, then states his own views to be the same. We would here most respectfully put the following difficulty which occurs to us, to Oriel. If you say that matter is force, we hope you will admit that force is matter; and, therefore, if, by out-flanking the question, in endeavouring to *take* grossness from matter, do you not at the same time *give* grossness to force? We do not insist upon this argument, because we feel, with Sir Roger de Coverley, "that much may be said on both sides."

Oriel then goes on to show our Dreamer (let us here confess that we had very nearly omitted the capital D) the "original element," and to prove that "this original element" is, "paradoxical as it may seem, *nothing*."

Up to this point we had travelled in all faith with our author; but when we find him gravely state that Oriel's next step was to make this "original clement" (which he admits to be nothing) revolve on its axis, we gave it up. We do not wonder, then, that after a few more feats, which Robert Houdin might have studied with advantage, our author says, "Despair took hold of me; my brain began to whirl, my feet to slip from under me, when—oh! relief!—I awoke; and it was a dream." At this point, we made a great discovery. "More light" is an allegory. Oriel means spirit; as we said before, highly rectified spirit; and thus we see that, under the influence of too strong a dose of "Oriel," we may expect our brains to whirl, and our feet to slip from under us.

Pharmacopoæ Recentiores, Anglica, Gallica, Germaniæ, Helvetica, Russiæ, inter se collatæ. Scripsit, præfatus est et indicem triplicem adjecit, H. Hager, Phil. Dr., Vratislaviæ. Günther, 1869.

This work will, undoubtedly, be appreciated by all really scientific medical men, as well as by pharmaceutists everywhere, and Dr. Hager deserves the greatest possible credit, and the sincere thanks of the profession for this publication. As the title indicates, he has compared, *inter se*, the pharmacopœias recently published in Great Britain, France, Germany (not to be confused with the Pharmacopoæ Borussica (Prussian), for the work here alluded to is in use in Central Germany, in dominions not as yet Prussianised) Switzerland, and, lastly, the immense Russian empire.

Throughout this work, the rule of most continental pharmacopœias, that weighing shall almost always be resorted to, instead of measuring, has been rigidly adhered to, and the measures of the British pharmacopœia have been reduced to weights as far as possible. The book is alphabetically arranged, and is, therefore, easy for reference.

Taking a couple of instances, almost at random, we observe, in the Russian codex only, a very excellent prescription for making magnesia sulphurosa (sulfis magnesiæ), a salt now used internally in this country. The French codex has syrupus chinini sulphurici (sirop de sulfate de quinine), a useful preparation to give to young children, if required.

There are added to the work (1st) very useful tabulated forms, taken from the Swiss and German codices, wherein are indicated the single doses of the more active preparations and compounds *above* which the substances named should not be dispensed, *unless* the medical man who prescribes *distinctly* requires higher doses to be given; (2nd) indices or reference in the French, English, and Latin languages.

The book is well printed, in clear type, by M. Günther, at Breslau.

Labels for Chemical Substances. In paper wrapper, price 6d. London: John J. Griffin and Sons, 22, Garrick Street, W.C.

In a recent number, we noticed several editions of chemical labels. We have since received another book, containing 195 labels, admirably arranged by A. Vernon Harcourt, M.A., F.R.S., Secretary to the Chemical Society, and H. G. Madan. The nomenclature is similar to that adopted in "Fownes" and "Roscoe." The labels for solutions contain an indication of the strength of the solution, and an explanation of the expressions used is also given. We are told that a book on laboratory practice, by the same authors, will shortly be issued.

Spectrum Analysis: six lectures delivered, in 1868, before the Society of Apothecaries of London. By H. E. Roscoe, B.A., F.R.S. Macmillan and Co., 1869.

Lessons in Elementary Chemistry; Inorganic and Organic. By H. E. Roscoe. New Edition. Macmillan and Co., 1869.

Few men are so competent as Professor Roscoe to discuss the various processes and results of spectrum analysis. He has worked much on the subject of light, sometimes alone, sometimes with the men who founded the mode of analysis under discussion: it will also be remembered that he was the first to introduce the subject in a practical form to the attention of scientific men in this country; and he has translated many important memoirs relating thereto into English during the last few years.

The work before us appears at a peculiarly opportune time, since the recent spectroscopic observations of the eclipse of 1868, and the brilliant results in stellar chemistry obtained yet more recently, have made this branch of science perhaps more prominent than any other, whether we look to the novelty and magnitude of its deductions, or to the fact that it enables us to exercise, not alone a cosmic analysis, but a system of analysis embracing the universe.

Starting with Newton's discovery of the composition of white light, Professor Roscoe passes to the consideration of the properties of sunlight, and of the various coloured rays composing white light. The key-note of the whole subject was struck by Newton, in 1675, in the demonstration that "lights which differ in colour, differ also in refrangibility;" he proved, at the same time, that light which has once passed through a prism cannot be further decomposed, and that the various coloured rays constituting white light, when brought together again after decomposition, form white light. The author next considers the various conditions of different portions of the spectrum, and gives illustrations of the fact that the calorific intensity of the spectrum attains a maximum near the red end of the spectrum, while the chemical intensity culminates near the violet end of the spectrum. An account of Fraunhofer's lines concludes the first lecture.

A noticeable feature of the work is the addition of an appendix to each lecture (often exceeding in length the lecture itself), in which extracts from the more important of the memoirs quoted are given, and the most recent discoveries—too late for insertion in the text of the lectures—are described. In the appendix to the first lecture, a lengthy extract is given from Newton's "Optics," regarding the *modus* of the original experiment on the decomposition of light. There are, also, some remarks on the application of magnesium wire as a source of light for photographic purposes, in the course of which it is stated that "a burning

magnesium wire, of the thickness of 0·297 millimetre, evolves . . . as much light as seventy-four stearine candles of which five go to the pound."

The second lecture treats of the spectrum of incandescent solids and gases, and the method of producing and examining their spectra. In speaking of the delicacy of the method of spectrum analysis, it is stated that 180,000,000th part of a grain of sodium can be readily detected; 6,000,000th of lithium, and 1,000,000th of strontium. Among the more important results produced by this branch of the subject, is the discovery that lithium, previously known to exist in but four minerals, is now found to be one of the most widely-distributed metals. An interesting account is appended to this lecture of Bunsen and Kirchhoff's mode of working with the spectroscope.

The third lecture contains an historical sketch of the rise and progress of spectrum analysis, and an account of the various new elements discovered by its means. We learn from this that, so far back as 1822, the spectra of many-coloured flames were examined by Sir J. Herschel. On page 96, elaborate analyses are given of the mineral waters in which cæsium and rubidium were first discovered. The lecture concludes with an account of, perhaps, the greatest application of spectrum analysis to the purposes of the manufactures which has yet been made, viz., its application to the process of making steel by the Bessemer process. In this operation, it is of the utmost importance that the operation of blowing air through the molten metal should be stopped the instant that the proper amount of carbon has been removed from the metal. "If the blast be continued for ten seconds after the proper point has been attained, or if it be discontinued ten seconds before that point is reached, the charge becomes either so viscid that it cannot be poured from the converter into the ladle from which it has to be transferred to the moulds, or it contains so much carbon as to crumble up, like cast-iron, under the hammer." The precise moment to stop is judged of by examining the flame as it issues from the mouth of the converter, by means of a spectroscope, and the moment that the carbon lines disappear from the field of view, the blast is shut off.

In the fourth lecture, Professor Roscoe discusses the spectra of metals volatilised in the electric arc, a subject which received much attention from Angström in 1855, he having mapped no less than 32 spectra, while Mr. Huggins has mapped 24. Thalén has recently investigated and mapped the lines of some of the rarer metals; among them, glucinum, thorinum, and zirconium. At page 156 will be found two very admirable maps of metallic lines, from the drawings of Mr. Huggins, and these are followed by extracts from the memoirs in which he describes them.

In the fifth lecture is commenced the important subject of solar and stellar chemistry, an account is given of the discovery of the coincidence of the dark solar lines with bright metallic lines, of Kirchhoff's explanation of the cause of the coincidences and the deduction therefrom of the well-known theory of the constitution of the sun. We find here two very beautiful reductions of Kirchhoff's maps of the solar spectrum, together with the map of Angström and Thalén, of the spectrum from G to H_2 drawn to the same scale. An experiment is described on page 191 in which "a constantly burning black soda flame" is produced by viewing a soda flame through a surrounding shell of soda flame; this is an admirable experiment for a large audience, provided they are not seated on gradually ascending seats, when of course many look down upon the inner soda flame without looking through the surrounding flame. The appendix to this lecture contains a detailed account of the spectroscopic observations of the solar eclipse of 1868.

The last lecture is devoted to the subject of stellar chemistry, and is accompanied by a beautifully coloured map of the spectra of various stars and nebulæ, among them Sirius, and the blue and orange stars of β Cygni. The spectra of Aldebaran and α Orionis drawn to scale are given on page 235; in these stars no less than seventy lines have been observed, and Dr. Miller and Mr. Huggins have detected nine elements in Aldebaran, which, strange to say, include bismuth (not found in the sun), tellurium, antimony, and mercury. Finally, the spectra of comets and nebulæ are discussed, and it is stated that Brorsen's small comet, which is now visible, has been found by Mr. Huggins to give lines dissimilar to those yielded by any substance known on earth. The final appendices contains very lengthy abstracts from the memoirs of Huggins and Miller on stellar spectra, Kirchhoff's elaborate tables of the coincidences of the bright lines in the spectra of the metals with the dark solar lines, and the work is terminated by a list of the principal memoirs on spectrum analysis, divided into three parts. (1) "Lectures or Memoirs Relating to the subject of Spectrum Analysis generally," eighteen in number; (2) Memoirs relating to the Application of Spectrum Analysis to Terrestrial Chemistry," ninety-four in number; (3) "Memoirs relating to the Application of Spectrum Analysis to Celestial Chemistry," seventy-five in number.

The great extent of the literature of the subject well indicates the rapid growth (mainly since 1861) of the science of spectrum analysis, and we have in the work before us a condensed account of everything of importance which has been done in connection with it from the pen of a man who has himself contributed no insignificant labours in this direction. As to the book itself, it is clearly and concisely written, and is in no place unnecessarily complex. The numerous illustrations, together with the maps and coloured plates, tend greatly to simplify the more abstruse matters, and we heartily recommend the book to the general as well as to the scientific reader.

We are glad to notice the issue of a new edition of Professor Roscoe's useful "Lessons in Elementary Chemistry," a work now generally used by the junior classes in those schools (happily on the increase) in which natural science is taught. The present edition contains no less than fifty-six pages more than the edition of 1866, together with a few additional woodcuts; the index is very complete and comprehensive, and the examination questions have proved of service to science masters: we feel assured that this work will continue to occupy the position which it has gained among our school books.

Observations on some of the Fundamental Principles and Existing Defects of National Education. By Neil Arnott, M.D., F.R.S., &c. Longmans, 1869.

In about 32 duodecimo pages, Dr. Arnott very clearly sketches the outline for a good and useful system of education. The little book opens with what is very aptly called a general map or table of human knowledge, showing the natural divisions. The first embraces the three Kingdoms of Nature; the second the four orders of changes or phenomena among things, the knowledge of which is called Science. The third division is divided into two sections; (*a*) the two arts by which man acquires and stores knowledge; (*b*) industrial arts, fruits of human invention.

This is a comprehensive scheme, but it certainly appears to be the right way. The subjects just enumerated are briefly but lucidly explained and discussed in the subsequent pages of the book, which is a very valuable shilling's worth.

Proceedings of the American Association for the Advancement of Science; Sixteenth meeting, held at Burlington, Vermont. Cambridge, U. S.: J. Lovering. 1868.

It will be new to some of our readers to hear that there exists an American Association for the Advancement of Science, corresponding to our British Association, and that the meeting which is chronicled in the work we are about to discuss is the sixteenth meeting of that association. The institution and support of such an association indicates a zeal for science among our American brethren which is surely a

good omen, and a healthy sign of the times. Nothing more conduces to the spread of a love for science, and to the diffusion of scientific knowledge, a tutored scientific taste, and a *modus* of scientific thought, and nothing more encourages original research, than the banding together of scientific men for the one purpose of furthering each his individual study and pursuit. And what greater proof of this can be needed than that which Europe furnished in the seventeenth century? The downfall of Aristotelianism, and the consequent spreading love for the "new philosophy," did not culminate in, but almost started with, the rise of numerous scientific societies—the Accademia del Cimento, the Royal Society, the Collegium Curiosum, and the Académie des Sciences, all appeared in less than half a century after the death of Bacon and Galileo. A period of great intellectual activity exists not without the blossoming and blooming of such institutions, and they react on the period, and induce in it a greater charge of intellectual vigour. In a country like America, mighty in great works, the effect of such an association, if well supported, ought to be immense. We say "mighty in great works," because the opening of the Pacific Railway is yet in our minds, and, if there had not been some hundreds of eighth wonders of the world since the hanging gardens of Babylon were, with her "Babylon magna, mater fornicationum et abominationum terræ," razed to the ground, and since the Rhodian Colossus was broken up and sold as old brass, we think that the Pacific Railway would be that eighth wonder. Perhaps the only work to be compared with it for extent and magnitude is that other among the ancient (and modern) wonders of the world, the Great Wall of China; let us, however, remember that the Suez Canal and the Mont Cenis Tunnel are approaching completion, and will soon have to be placed in the same category with the Pacific Railway. But we are plunging into a theme which, if extended, will bear us far from our present subject.

The subjects which engage the attention of the American Association for the Advancement of Science are thus divided: A. (1) Mathematics and Astronomy; (2) Acoustics; (3) Physics and Chemistry; (4) Physics of the Globe (or, as we usually say in this country, Meteorology). B. (1) Geology and Mineralogy; (2) Palæontology; (3) Zoology.

The Association possesses a President, Vice-Presidents, Standing Committees, and Local Committees; and it appoints special committees for the discussion of special subjects. Among the latter we notice "a Committee to report in relation to uniform standards in weights, measures, and coinage." The address of the President (Professor J. S. Newberry), although short, gives a fair *resumé* of the dominant subjects of the day, in regard to both the philosophy of matter and the philosophy of mind.

The first paper which calls for our notice is by C. S. Lyman, of New Haven (Conn.), "*On a New Form of Wave Apparatus.*" It is designed to illustrate waves whose "type is the ordinary ocean wave in deep water. The apparatus exhibits not only the wave profile, with its progressive motions, but also the motions taking place below the surface in the whole mass of liquid affected;" and it illustrates the wave theory established by Gerstner, Scott Russell, Rankine, and others. The apparatus could scarcely be described without the aid of a woodcut, but it somewhat resembles the wave apparatus invented some years ago by Wheatstone (?) We frequently wish that some apparatus of this description appeared upon the lecture table, especially in lectures on light and sound. The subject of plane polarised light is difficult enough, in all conscience; what, then, shall we say to circular and elliptic polarisation? Surely, some means of visualising these actions might, with advantage, replace the black-board, and the old story of the wire grating and the card, and the ray of light with its *two sides*, an expression nearly as appropriate, we always think, as that about the two sides of a round plum-pudding.

In a paper entitled "*Tellurium a Metal,*" Mr. L. Bradley adduces experiments and facts which compel him to regard tellurium as a metal. "It is true," he says, in conclusion, "that tellurium is not malleable, nor ductile, as are many of the metals; neither is bismuth nor antimony. Like the non-metallic substances, it unites with oxygen to form acid; so do antimony, arsenicum, gold, chromium, manganese, and many other metals. With hydrogen it unites to form a hydruret; so do potassium, arsenicum, and antimony. In short, it possesses the universally admitted distinguishing characteristics of metals, and nothing either in physical character or chemical behaviour which it does not hold in common with some other metals. I must, therefore, call it a metal."

We come now to a paper entitled "*Chemical Diagrams and Derivative Symbols, Illustrating the Prominent Characteristics of Chemical Elements.*" Here we are introduced to a species of diagram appertaining more to heraldry than to chemistry, albeit, there is a touch of alchemical mysticism introduced. They are, for the most part, a sort of half-bred between John Rudolf Glauber's three enigmatical designs and the illustrations to the article "Heraldry" in Chambers's old "Encyclopædia." What have we here? A black triangle; along the sides of which the words carbon, boron, and silicon appear, the whole surrounded by a shield. Here, again, is a shield, "simple," bearing a triangle, "proper," on a field, "argent." In the next diagram, the triangle has burst out eruptively, and is vomiting forth small jets of bromine, sulphur, tellurium, &c. The mysticism is obviously on the increase; is this a treatise *De Secretis* of the Middle Ages? At least, we recommend the author to peruse the "Pretiosa Margarita Novella." But what is this shield with a bar sinister? Have we illegitimate compounds in chemistry? If so, we rather imagine that pseudomorphs ought to be ranged under this head. A greater wonder yet remains: the author proposes to designate lithium, sodium, potassium, rubidium, and cæsium by a star with five points. He is, perhaps, unaware that the precise star which he has drawn is used in heraldry to designate a third son. Now, to say that a third son in heraldry, and five alkaline elements in chemistry, are symbolically the same, is palpably absurd. *Q. E. D.* And we are bound to confess that we must apply the same mode of argument to the whole of the paper. We would beg to suggest to the author the term "Heraldic Chemistry."

This paper is followed by another by the same author, on "*A New Chemical Nomenclature;*" and here his mystical longings crop up again with renewed vigour. The terms of the nomenclature are mystical, heathenish, barbarous—shall we add insensate? Without a doubt, they are closely related to the words wherewith, in former ages, many have tried and some have hoped to raise the devil. What shall we say to *kalamalt*, *nobamet*, *tanamet*? The "acid chromate of sesquioxide of chromium" rejoices in the name of *chreamyut*. The bromide of ammonium is *olanab*; sulphate of soda *natemasot* [happily, poor Glauber is dead], while chloride of sodium becomes *sodamad* (and we do not wonder at it, after such treatment). One more example, and we have done. "Bihydrochlorate of bibromoterchloronaphthaline" is to be called *eurulebod*, a term which must originally have been suggested by a Regius Professor of the language of the Feejee Islanders. The cardinal question yet remains. Whence comes this jargon? and what does it mean? We cannot tell, unless it is the production of that wonderful book-composing machine used by the Laputan philosopher, which took in letters and turned out completed books, in any language and on any subject; and we would venture to remind our author that hard by, was a philosopher, who proposed to build houses from the roof downward, beginning with the chimney-pots. In all seriousness, we say to the author of this paper, seek rather to discover new chemical facts than to generalise upon those already discovered; avoid mysticism, give up heraldry and bars sinister, and, above all, remember a very pertinent passage in the "De Augmentis Scientiarum" (and does not the title-page say "The American Association for the *Advancement of Science?*"), in which Bacon says with great felicity, "*Quocirca non certæ magis experientiæ quam rectæ etiam rationi*

consonum videtur, utres ponatur doctrinarum intemperies. Prima est doctrina phantastica, secunda doctrina litigiosa, tertia doctrina fucata et mollis: vel sic; vanæ imaginationes, vanæ altercationes, vanæ affectationes."

It only remains for us to say that the work we have considered contains several admirable papers, and that we wish all success to the "American Association for the Advancement of Science."

CORRESPONDENCE.

Equivalence and Quantivalence.

To the Editor of the Chemical News.

Sir,—No better proof can be wanted of the truth of Professor Williamson's remarks, upon the conflicting views held by chemists on the theories of equivalence and quantivalence, than a comparison of the opinions which those remarks have called forth.

Mr. Ward regards atomicity and quantivalence, equivalent and atomic weight, as synonymous terms. Mr. Orme describes the equivalent of an element as a varying quantity, from which the atomic weight is deduced by theoretical considerations, and from which it differs, being, of course, constant. Mr. Attfield tells us that the term equivalent is correctly used with "distinct meanings," that the equivalents of Cl, O, N, C, are 1, 2, 3, 4, "in regard to the exchangeable values of atoms," but $35\frac{1}{2}$, 8, $4\frac{2}{3}$, 3, "in displacing one part by weight of hydrogen." "Chemicus" seems to follow Wurtz in considering the term equivalence a substitute for atomicity.

Doubtless these conflicting ideas would be reconciled, and much vagueness overcome, by accepting the definitions given by Mr. Ward, but unfortunately for our peace of mind, we cannot adopt them, unless we shut our eyes to chemical phenomena and our minds to the reasoning of not less able chemists. Equivalence may justly be considered *ponderal*, but equivalent weight can scarcely be taken as synonymous with atomic weight, as Mr. Ward seems to think. Let it be for a moment considered that atoms represent forces—as may be done upon the supposition that saturated compounds are in a state of equilibrium—then we may suppose that the atom of phosphorus in such a compound as the pentachloride (PCl_5) exerts a force five times as great as one atom of chlorine, consequently $\frac{31}{5}$ will represent a force equal to that exerted by 35·5 parts by weight of chlorine, and may reasonably be said to be equivalent to it. No such equivalent relation, however, exists between 1 part by weight of hydrogen and 16 of oxygen.

The numerical nature of equivalence or atomicity is, of course, universally granted; a difference has, however, already arisen with regard to the use of these two terms, which Mr. Ward considers as synonymous. Naquet, in his excellent "Handbook of Chemistry," has preferred using the term atomicity for the maximum amount of saturation of which an element is capable, while he reserves the term quantivalence to express its varying saturating power. Thus he speaks of lead as being tetratomic, but forming a series of compounds in which it is bivalent. If atoms represent forces, they must be definite forces, which sometimes become latent, and it seems desirable to have a special nomenclature by which the degree of latency may be expressed.

Since, then, the word atomicity is objected to by chemists (not, I think, without cause), and the expression quantivalence has a special significance, I would suggest that the term equivalent *number* be used to express the *fixed* saturating power of polyatomic bodies. If this course were adopted, we should speak of an element, such as phosphorus, as having for its

Atomic weight	31
Equivalent weight	$\frac{31}{5}$
Equivalent number	5

And as forming compounds, such as PCl_3, it which it is trivalent, and others, such as PCl_5, in which its quantivalence and equivalent number are the same.—I am, &c.,

C. H.

Mawson and Swan's Labels.

To the Editor of the Chemical News.

Sir,—A thorough revision of the new Book of Chemical Labels, published by Messrs. Mawson and Swan, of Newcastle, has led to the discovery of three obvious errors of the press, which, I trust, you will permit me to point out. In the labels for Barium and Calcium Chlorides, the modern formulæ are printed as $BaNO_3$ and $CaNO_3$ respectively, instead of $Ba(NO_3)_2$ and $Ca(NO_3)_2$, and in the table of combining weights, the old number for Silicon is erroneously given as 14 instead of 28. By a singular mischance, one of the incorrect labels has been taken as a specimen for the publishers' advertisements. The indicated errors, which may be easily corrected by the pen, do not appear in the copies of the work which are now being used. The fact that only three mistakes are discoverable in a long series of formulæ may, perhaps, be deemed satisfactory evidence of careful compilation by those who have published chemical works, but after the precautions taken to insure correctness and consistency, even these few errors suffice to disturb the equanimity of

The Editor of the Book of Labels.

London, June 16th, 1869.

Quantivalence.

To the Editor of the Chemical News.

Sir,—The only apparent objection to the word quantivalence as a substitute for the expression atomicity is that mentioned by "C. H.," namely, that Naquet uses the latter term to indicate the maximum, and the former the varying saturating power of an element. Such limitations, however, are entirely unnecessary, and have not received general acceptance. Surely we may attack or defend the notion of constant against varying atomicity, otherwise synonymously termed quantivalence, without inventing special words or engaging in the vain endeavour to give to existing words fresh meanings in violation of etymology. Besides, if the question is to turn on priority, quantivalence was, I believe, originally offered by Hofmann as the pure equivalent of atomicity.

So much for the name; now for the subject. As a teacher of chemistry to large classes of students, I have found the doctrine of quantivalence of immense value to learners. At first, following good leaders, I treated radicals as if possessing, but not always exerting, constant quantivalence; latterly the one or two prevailing values of the (chemical) atom of the common elementary or compound radicals have been pointed out, the hypothesis of the self-contained or "latent" affinities of an atom being suppressed. This is the position I intend occupying until more evidence is forthcoming.

Reverting to the word. We recently heard one learned lecturer utter the barbarism monovalent, giving the accent to the last syllable but one; another speak of the barbarism pentavalent, also accenting the penultimate. I believe we simply follow rule in emphasising the third syllable from the end in the case of each of the words u-niv'-a-lent, biv'-a-lent, triv'-a-lent, quad-riv'-a-lent, quin-quiv'-a-lent, sex-iv'-a-lent. This matter is worthy of reference, inasmuch as, amongst other reasons, euphonious words are the most acceptable—quan-tiv'-a-lence has a better chance of employment than quan-ti-va'-lence. Taking for guidance the pronunciation accorded to the old word e-quiv'-a-lent, there need be no difficulty in this matter.—I am, &c.,

John Attfield, Ph.D.,
Professor of Practical Chemistry to the Pharmaceutical Society.

Artificial Manures:

A COMMON SENSE VIEW OF THE PRECIPITATED PHOSPHATE QUESTION.

To the Editor of the Chemical News.

Sir,—I have perused Mr. Hughes's paper with some interest, but more of astonishment. Is it or is it not the fact, that the greater part of the soluble phosphate of lime supplied to the soil in superphosphates is very speedily converted into precipitated or reduced phosphates, *i.e.*, insoluble in cold water? If it be a fact (and Mr. Hughes will hardly dispute it), why does he ask the manufacturer to make the farmer a present of some 3 to 6 per cent of valuable phosphates, for all intents and purposes of agriculture equal to soluble phosphates? Doubtless, Mr. Hughes is a very good chemist; but, in his zeal in combating the unfair use of oxalate of ammonia as a solvent for *reduced* soluble phosphates, he has rushed off to the other extreme. In his hot haste, and fresh from his "half-hours" of stewing coprolites, first with half their weight, and then with double their weight of oxalate, he rashly seeks to *rob* the manufacturer of his hardly-earned soluble phosphates! and, no doubt, the next farmers' club that sends a set of samples to Mr. Hughes for analysis will get them analysed on this principle. Nearly all superphosphates in good condition, from having lain long in the pile, contain more or less of this reduced soluble phosphate. Will Mr. Hughes or Dr. Voelcker contend that, because Mr. Chesshire has used a faulty process (if it be so), and, by boiling for half-an-hour, may have obtained more soluble phosphate from his samples than their respective bulks contained, that therefore the manufacturers are to be fined half-a-crown (or some such sum) per ton for every unit of soluble phosphate which has become reduced in the pile? This is a matter of very serious importance to manufacturers, and one which it behoves chemists, and especially so-called agricultural chemists, to settle.

May I venture to suggest that, if Mr. Hughes will abjure hot water in his examinations for soluble phosphates, he will get more correct results, and, if he had used a cold and very dilute solution of the oxalate, his experiments would then have been of more value. Again—for his own satisfaction, and by way of testing this matter—will Mr. Hughes perform an analysis of the clear solution obtained by pouring distilled water on to superphosphate on a filter; and then let him take another portion of this solution, and *reduce* the whole of the soluble phosphate by precipitating it with ammonia or lime-water. He will then have some precipitated phosphates on which to operate, and, if he will send you his results, I doubt not they will be of some practical value. He will then be able to say the minimum of oxalate of ammonia required to re-dissolve this phosphate, which he now wishes the manufacturer to give to the farmer for next to nothing.—I am, &c.

Fair Play.

London, June 14th, 1869.

NOTES ON LECTURE EXPERIMENTS.

Combustion of Sodium.—The metal sodium is stated not to take fire on cold water, but this is incorrect. A small piece of the metal will not do so, but a piece the size of a nut will frequently ignite; the flame may suddenly "pop" out, and it may as suddenly become ignited again. It is also addicted to the unpleasant habit of suddenly bursting into fragments, and throwing the fragments of metal in all directions. After the combustion of any considerable quantity of the sodium, it is curious to observe how the soda may be seen tinging with a yellow colour the non-luminous portion of any gas jet that may be burning.—G. N. M., Northampton, May 26, 1869.

LABORATORY NOTES.

Phosphorus Holder.

To the Editor of the Chemical News.

Sir,—A few inches of lead tube, ¼ in. bore, is contracted to an open cone, at one end. As much phosphorus as one may choose is put into the cone of the tube; the phosphorus is made to project slightly from the cone; the upper part of the tube is filled with water, and corked. Thus is had a phosphorus "crayon" perfectly safe in the hand for luminous writings, &c.

To put in the phosphorus, as much as may be required is melted in a conical glass, or test-tube, the cone of which is larger than that of the lead tube.

This is put standing in the melted phosphorus, which fills the cone and tube to its own outside level. When cold, there is a nice projecting crayon, from the form of the glass. Any phosphorus outside the lead tube may be melted off.

To renew the writing point, a test-tube, conical below, is fitted to the cone of the lead; the whole held in warm water for a minute, as much phosphorus flows out as forms a new point. E. Kernan.

Phosphuretted Hydrogen.

To the Editor of the Chemical News.

Sir,—The solution of caustic potash and phosphorus are put into anything like an evaporating basin. On the application of heat, the gas comes off, taking fire at various points of the liquid surface. The cup may be very small, even a watch glass will do.

The basin with its contents may be put aside until required to act again. Even when quite cold, odd bubbles of gas come off.

An objection to this method is that the "rings" do not show; the gas bubbles are too small, and burst before they can unite to form one large one strong enough to overcome the air currents. Could this be effected, the open basin would be a considerable improvement on the retort production of phosphuretted hydrogen. E. Kernan.

Laboratory Pump.

To the Editor of the Chemical News.

Sir,—I forward a description of a slight addition which I have devised to the valuable filter pump of Professor Bunsen, whereby the filtrate, if required, may be retained for further research.

Take an ordinary bell-glass receiver used in collecting gases, open and ground at the bottom, and closed at the neck with a stopper. Remove the stopper, and replace it by a cork, through which passes the funnel and exhausting tube, as shown in the flask in Professor Bunsen's arrangement. The receiver can then be placed on a glass plate, a beaker introduced within it, and the joint between the receiver and the plate made good with a little tallow. The funnel should be lengthened by fusing a piece of glass tube to it, so that it may reach half way down the beaker, as the liquid dropping from the funnel in the rarefied medium is very apt to splash upwards. John Dods.

Laboratory, Crewe Works,
L. and N.-W. Railway Co.

Blowpipe Reaction of Thallium.

To the Editor of the Chemical News.

Sir,—When either oxide of thallium is melted with borax, it gives a clear, colourless bead; but when this is kept for some time at a heat much below redness, the outside turns deep brown, owing to the formation of thallic oxide. On raising the temperature, it is again reduced to thallous oxide, small bubbles of oxygen are set free, and the bead again becomes colourless. I am not aware that any other substance behaves in the same manner.

H. C. Sorby.

MISCELLANEOUS.

Collodion for Protecting Silver Ware.—The loss of silver which results from the impregnation of our atmosphere with sulphur compounds, especially where gas is burned, is very great. It has been said that many thousands of pounds' worth go down our sewers annually in the form of dirt from plate cleaning, and the loss of one large house on Cornhill from this source has been described to us as serious. Silversmiths may, then, thank one oft heir confraternity—Herr Strollberger, of Munich—for a happy thought. He seems to have tried various plans to save his silver, if possible. He covered his goods with a clear white varnish, but found that it soon turned yellow in the window, and spoilt the look of his wares. Then he tried water glass (solution of silicate of potash), but this did not answer. He tried some other solutions, to no purpose; but at last he hit upon the expedient of doing his goods over with a thin coating of collodion, which he finds to answer perfectly. No more loss of silver, and no longer incessant labour in keeping it clean. The plan he adopts is this: He first warms the articles to be coated, and then lays them carefully over with a thinnish collodion diluted with alcohol, using a wide, soft brush for the purpose. Generally, he says, it is not advisable to do them over more than once. Silver goods, he tells us, protected in this way, have been exposed in his window more than a year, and are as bright as ever, while others unprotected have become perfectly black in a few months.—*Mechanics' Magazine.*

A New Alloy (says *Iron Age*), forming, we are told, a beautiful white metal, very hard and capable of taking a brilliant polish, is obtained by melting together 70 parts of copper, 20 of nickel, 5½ of zinc, and 4½ of cadmium; it is, therefore, a kind of German silver, in which part of the zinc is replaced by cadmium. It is used largely in Paris for the manufacture of spoons and forks, which resemble articles of silver.

Amalgamation of Zinc for Galvanic Batteries.—In a somewhat lengthy, and not by any means very lucidly written, paper in *Les Mondes*, M. D'Almeida has described a series of experiments made by him with amalgamated zinc and other metals, and, moreover, with polished substances, such as glass, to prove that the cause of the very far less rapid solution and attack of zinc and other metals when placed in contact with acids, which, unless the said metals were amalgamated, would rapidly corrode and dissolve the same, is due, after amalgamation especially, to the physical change of the surface of the metal, and, as a consequence thereof, the adhesion to the metal of a thin layer of very minute bubbles of hydrogen gas retained to that surface by capillary action, and, as a consequence of their presence, the non-immediate and direct contact of the metal with the acid it is immersed in, but action of the latter upon the former through a layer of very minute bubbles of gas, which appears to be one of the causes of the slower corrosion of amalgamated zinc. The author has made a series of experiments, too long to be described in detail, which, certainly as far as the description goes, appear to prove his theory on this subject.

New Work by Dr. Odling.—Shortly will be published, in 1 vol., "Outlines of Chemistry; or Brief Notes of Chemical Facts," by William Odling, M.B., F.R.S., &c., Fellow of the College of Physicians, and Fullerian Professor of Chemistry at the Royal Institution. This volume will consist of the notes from which the author has lectured for the last six years at St. Bartholomew's Hospital, revised and somewhat extended, so as to furnish the student with a connected outline of the leading facts of chemistry in their relation to each other. It will be essentially descriptive in its character, and aim at calling to mind, in as few words as possible, the ascertained origins, properties, and metamorphoses of chemical substances. It will include a systematic account of the monad, diad, and triad non-metallic elements, and their principal combinations with each other; of silicon and carbon, with its series of methylic, formic, and cyanic compounds; and of the various metals, arranged, as far as practicable, in natural groups, with their respective series of halides, oxides, and oxisalts, &c.

Extraordinary Phenomenon.—The Caspian Sea or Lake is dotted with numerous islands which produce yearly a large quantity of naphtha, and it is no uncommon occurrence for fires to break out in the works, and burn for many days before they can be extinguished. Early last month, owing to some subterraneous disturbances, enormous quantities of naphtha were projected from the wells and spread over the entire surface of the water, and, becoming ignited, notwithstanding every precaution, converted the sea into the semblance of a gigantic flaming punch-bowl, many thousands of square miles in extent. The fire burnt itself out in about forty-eight hours, leaving the surface of the water strewed with the dead bodies of innumerable fishes. Herodotus mentions a tradition that the same phenomenon was once before observed by the tribes inhabiting the shores of the Caspian Sea, which exceeds in area that of England and Scotland together.

Essential Oil of Cochlearia officinalis.—It appears that this essential oil has been frequently confused with the essential oil of mustard, from which the author (Dr. A. W. Hofmann), on experiment, found it essentially different. The boiling point of the oil of *Cochlearia* is at about 160° C., that of the genuine oil of mustard at 147° C. On being treated with ammonia, the essential oil of *Cochlearia* yields a beautifully crystallising substance (the thiosinnamin of the essential oil of *Cochlearia*), which fuses at 135° C. Analyses of the oil and the ammonia compound just alluded to, prove the oil to be the mustard oil (*Senfol*), of the butyl series—

$$\left.\begin{matrix} C_5H_9NS = C_4H_9 \\ CS \end{matrix}\right\} N.$$

When butylamine (prepared from butyl alcohol by fermentation) is treated with sulphide of carbon and chloride of mercury, a mustard oil is obtained of the same composition and about the same boiling point, but the odour indicated that only an isomeric substance had been obtained, and further research proved that the ammonia compound of the oil, thus artificially produced, had its melting point at 90° C. The author intends to proceed with researches on this subject. — *Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

Memorial to Faraday.—A public meeting, at which H R.H. the Prince of Wales will take the chair, will be held at the Royal Institution on Monday next, June 21st, at half-past 3, to consider the measures to be taken for the promotion of a memorial to Faraday.

Proposed New Physical Society.—It has been proposed to establish a Physical Society in London, and already many promises of support and proposals for membership have been received. We shall be glad to receive the views and opinions of our readers on this subject.

The British Association.—At a meeting of the council, on Saturday last (June 12th), Sir Roderick Murchison in the chair, it was reported by the General Secretary that the following Presidents of sections had consented to preside at the Exeter meeting. The following Vice-Presidents were nominated:—Section A (Mathematical and Physical Science). — President, Professor Sylvester, F.R.S.; Vice-Presidents, Professor Adams, F.R.S., and Mr. W. R. Grove, Q.C., F.R.S. Section B (Chemical Science).—President, Dr. Debus, F.R.S.; Vice-Presidents, Professor Odling, F.R.S., and Professor Williamson, F.R.S. Section C (Geology).—President, Professor Harkness, F.R.S.; Vice-Presidents, Mr. R. Godwin-Austen, F.R.S., and Mr. W. Pengelly, F.R.S. Section D (Biology).—President, Professor Rolleston, F.R.S.; Vice-Presidents, Mr. C. Spence Bate and Mr. E. B. Taylor.

Section E (Geography).—President, Sir Bartle Frere; Vice-Presidents, Sir George Grey, K.C.B., and Mr. A. G. Findlay, F.R.G.S. Section F (Economic Science and Statistics).—President, the Right Hon. Sir Stafford H. Northcote, M.P.; Vice-Presidents, Mr. T. D. Acland, M.P., and Colonel Sykes, M.P., F.R.S. Section G (Mechanical Science).—President, Mr. C. W. Siemens, F.R.S.; Vice-Presidents, Mr. G. P. Bidder, F.R.G.S., and Mr. C. Vignoles, F.R.S. The Mayor of Exeter, Sir Stafford Northcote, and Sir John Bowring were present, and supported the application of the working men for a special lecture during the meeting, which was unanimously agreed to, and subsequently Professor W. A. Miller, Vice-President and Treasurer of the Royal Society, was invited to undertake the duty.

Bleaching Soap.—This is a soda soap prepared according to the excellent prescription of the Prussian Pharmacopœia, which prescription has been copied in almost all other works of the kind; the soap is separated by common salt, and after this one-fourth of its weight of sulphite of soda is added, which has been previously made into a homogeneous paste by means of a little water; the soap is next dried in the usual manner. In order to apply this soap, chiefly intended for the bleaching of straw hats, but perfectly fit for application to silk and wool, it is dissolved in its own weight of cold water, and to every 2 lbs. of soap, ½ oz. of liquid ammonia is added. As soon as the mass has assumed a gelatinous aspect, 1 part thereof is dissolved in 8 parts of warm water. The materials which it is desired to bleach are washed and scrubbed by means of a brush in this soap-sud; while yet moist, the materials are placed in acidulated water (25 parts of water and 1½ of hydrochloric acid), left in this liquid for 2 hours, and then well washed, and rinsed with pure cold water, and dried. This soap is very largely and successfully used in Russia, and was first prepared in that country by Dr. Werner.—*Pharm. Zeitschr. f. Russl.*

Death of M. Berard.—We learn from the *Messager du Midi*, a daily paper published at Montpellier, that M. J. E. Berard died in that city on the 10th inst., at the advanced age of nearly 80 years. The deceased, a celebrated chemist, was born at Montpellier, on the 12th of October, 1789. He was first Professor of Chemistry of the Faculty of Sciences at Montpellier, and held simultaneously the Professorship of Chemistry of the Ecole de Pharmacie established in that city. For about the last twenty-five years he has been, first the active, afterwards honorary Dean of the celebrated Faculty of Medicine of the University of Montpellier—a post of honor and influence—and he has been well known in various scientific circles. He was a member of several learned societies, the owner of large chemical works, and a man of independent means—a very courteous, but yet somewhat haughty, scientific diplomatist; he was a staunch upholder of the rights of the Université de France, and, at the same time, in politics a constitutional liberal. Those who have been personally acquainted with him, like the writer of these few lines, can testify that he was an eloquent and highly accomplished lecturer, an eminently successful experimenter, kind and forbearing with the students of his class, who, on an average, numbered from 1,000 to 1,800.

London Institution.—We have received the report of the above institution, from which we find that it is proposed to adapt the chemical resources of the Institution to the practical teaching of chemistry. The following is an abstract of Professor Wanklyn's "Laboratory Report for the Session 1868-9":—In addition to the annexed list of papers [a list of eleven papers follows, abstracts of which have appeared in our columns] from the Laboratory, it should be mentioned that a very elaborate memoir on the alcohols of fermentation, by my friends Messrs. Chapman and Smith, has been laid before a recent meeting of the Chemical Society, and is in course of publication in the "Journal." Much of the recent investigation has consisted in an elaborate confirmation of M. Wurtz's results—a circumstance which is not unimportant, regard being had to the great improvements in method which have been introduced since the date of M. Wurtz's investigations of butylic alcohol. The recent discovery of isomeric forms of the alcohols, and the exceedingly interesting structural differences presented by these isomers, give additional value to a careful study of a natural alcohol, such as butylic alcohol. The Royal Society has testified its approval of investigations such as this by making a grant of £50 to Mr. Chapman for the prosecution of researches of this character. In the paper entitled "*Researches on the Ethers*," read at the meeting of the British Association in Norwich, there is recorded a work in contradiction of a very important set of results published by eminent English Chemists a few years ago. The result contradicted is, that an acetic acid had been produced in which part of the *radicular* hydrogen had been replaced by the metal sodium, so as to yield sod-acetic acid, or, more correctly, sod-acetic ether. It has been shown that, contrary to the assertion of two English chemists, there is no driving out of hydrogen by the action of sodium on acetic ether. As a consequence of the disproof of the elimination of hydrogen, a huge superstructure of unsound chemical theory has been destroyed. In conclusion, I would just call attention to the very interesting set of compounds—the salts of the new organo-metal, ethylene-sodium—which have been recently discovered in the laboratory of the institution, and which are being investigated at the present moment."

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1277. J. Scharr, Stuttgard, Wurtemburg, "Improvements in the manufacture of liquid soap."—Petition recorded April 24, 1869.

1391. C. D. Abel, Southampton Buildings, Chancery Lane, "Improvements in the treatment of cast-iron for the production of wrought-iron and steel therefrom."—A communication from W. M. Lyon, Pittsburg, Penn., U.S.A.—May 6, 1869.

1409. F. C. Knowles, Lovell Hill, Berks, "A new or improved method of purifying and converting cast-iron into malleable iron or into steel, and for the making and use of materials and appliances for the same."

1413. E. Maybury, G. Matthews, and E. Marston, Pendleton, Lancashire, "Improvements in puddling furnaces."—May 8, 1869.

1414. R. Cadbury and G. Cadbury, Birmingham, and J. M. Randall, Torquay, Devonshire, "A new or improved description of biscuit manufactured from the cacao bean."—Petition recorded May 8, 1869.

1418. H. R. Lumley, St. John's Wood, "The treatment of molten iron in order to free it from all impurities."

1419. H. A. Dufrené, Rue de la Fidélité, Paris, "Improvements in desiccating and preserving meat and other organic substances."—A communication from C. Tellier, Passy, Paris.

1426. W. E. Newton, Chancery Lane, "An improved process and composition for hardening common or grey cast-iron, and for converting articles of iron into steel, or imparting thereto a steely character."—A communication from B. W. Nichols, Canton, Ohio, U.S.A.

1431. H. Bessemer, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in furnaces and apparatus employed for their fusion and treatment."

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1433. H. Bessemer, Cannon Street, London, "Improvements in the conversion of fluid crude iron and molten pig, or other carburets of iron, into fluid homogeneous malleable iron and steel, whether such pig or other crude iron is used alone, or is mixed with a portion of malleable, or more or less decarburised iron, in a solid or fluid state."

1434. H. Bessemer, Cannon Street, London, "Improvements in the treatment of crude or pig-iron, and other carburets of iron, and in the apparatus employed for such purposes."—May 10, 1869.

1435. H. Bessemer, Cannon Street, London, "Improvements in the construction and mode of working blast furnaces employed for smelting the ores of iron, and in the mode of employing and utilising the gaseous products of such furnaces, and also in the construction and mode of working blast engines employed to force air into blast and other furnaces."—May 10, 1869.

1440. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved detergent, or saponaceous compound."—A communication from W. H. Newton, New York, U.S.A.—May 11, 1869.

[English Edition, Vol. XIX., No. 498, pages 296, 299; No. 499, page 310; No. 496, page 275.]

1450. J. Robey, Newcastle-under-Lyme, "Improvements in sugar refining."

1458. P. W. Flower, Neath, Glamorganshire, H. Nash, Water Street, Liverpool, and R. Heathfield, Birmingham, "Improvements in coating sheets of metal with other metals."—May 12, 1869.

1464. E. V. Newton, Oxford Street, Middlesex, and P. M. Crane, Manchester, "A new or improved composition for coating ships, boats, and other surfaces, and for protecting and preventing the fouling thereof."

1469. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or treating oils and fats, and in apparatus therefor."—May 13, 1869.

1483. G. Felix, H. J. Axel, F. Bang, F. Roch, C. Monestier, and J. P. A. Fignier, Paris, "An improvement in liquids for the lubrication of sheep's or other wool, or other animal textile fibrous materials."

1486. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of beet-root and other pulps, and in the machinery or apparatus employed therein."—A communication from H. Champonnois, Paris.—May 14, 1869.

1493. L. A. V. Dubourg, M.D., Leicester Street, Leicester Square, Middlesex, "Improvements in the manufacture of gas for lighting and heating purposes, and in the apparatus employed therein."

1435. W. Wilkinson, Seymour Street, Euston Square, Middlesex, and M. Boss, Cleveland Street, Fitzroy Square, Middlesex, "Improvements in embossing, printing, enamelling, and ornamenting glass, metal, wood, canvas, or other woven prepared fabrics or other substances, and the preparation of the material, or materials and ingredients employed therein, and machinery or apparatus appertaining to a part thereof."— May 15, 1869.

1540. G. Martin, Dursley, Gloucestershire, "Improvements in the means of generating gases and chemical vapours employed in the manufacture of extract wool, and in destroying the vegetable material in mixed fabrics, and in the construction and arrangement of apparatus therefor, which apparatus is also applicable to other purposes."—May 19, 1869.

1562. J. McMillan, Dumbarton, N.B., and J. McGregor, Glasgow, N.B., "Improvements in the preservation of iron and steel, and structures composed thereof."

1568. G. Johnson, San Francisco, California, U.S.A., "Improvements in the distillation of spirituous liquors, and in apparatus to be employed therefor."—May 20, 1869.

1243. A. Borgnet, Swansea, Glamorganshire, "An improved composition to be employed as a paint."—Petition recorded April 22, 1869.

1539. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for obtaining gelatine and other products from animal substances."—A communication from D. K. Tuttle, O. Lugo, W. J. Hooper, and T. Hooper, Baltimore, Md., U.S.A.—May 19, 1869.

1575. C. W. Siemens, Great George Street, Westminster, Middlesex, "Improvements in calcining and smelting ores, and in furnaces and apparatus employed in connection therewith, which furnaces are also applicable to other purposes."—May 21, 1869.

1582. H. R. Lumley, St. John's Wood, London, "Improvements in treating and purifying crude iron, and in making steel, and in an apparatus for such purpose."—May 22, 1869.

1523. W. Benson, Hexham, Northumberland, "Improvements in treating or reducing ores, and in apparatus employed therein."—Petition recorded May 18, 1869.

1632. F. A. Barrow, Glasgow, N. B., "Improvements in purifying or bleaching mineral oils."—May 27, 1869.

1642. J. Brönner and H. Gulzkow, Frankfort-on-the-Maine, "An improved method of obtaining anthracen out of asphaltos—that is to say, pitch produced from coal tar—and of preparing two colouring matters from the anthracen."

1652. A. T. Fairgrieve, West Street, Sunderland, "An improved paste or composition adapted for coating the bottoms of wood and iron ships."—May 28, 1869.

1668. P. Kirk, Workington, Cumberland, "Improvements in puddling furnaces, and in other furnaces employed in the manufacture of iron and steel."—May 31, 1869.

1691. H. Browning, Salmon Lane, Limehouse, Middlesex, "Improvements in compositions suitable for use as varnish or paint."—June 1, 1869.

1700. G. V. Turnbull, C. Salvesen, and R. Irvine, Leith, N.B., "Improvements in the manufacture or preparation of lubricants or softeners, and the application of the same to the treatment of hemp, jute, flax, and other like fibrous materials."

1706. H. Larkin, Torriano Cottages, Leighton Road, and W. White, Thurlow Road, Hampstead, Middlesex, "Improvements in the manufacture of magnesium, and in the preparation of its anhydrous chloride."

1710. A. L. Simpson, Stowmarket, Suffolk, "Improvements in compositions suitable for treating sheep attacked by fly, and for other similar purposes."—June 2, 1869.

NOTICES TO PROCEED.

3959. G. T. Bousfield, Brixton, Surrey, "Improvements in extracting the colouring matter of madder root from the ligneous matter of the plant."—A communication from A. Paraf, New York, U.S.A.—Petition recorded December 29, 1868.

18. H. A. Bonneville, Chaussée d'Antin, Paris, "Certain improvements in the process of refining iron and making steel, and in the apparatus used in carrying out said process."—A communication from C. J. Caunnon, Toulouse, France.—January 4, 1869.

42. K. Walter, Wicklow, "Improvements in the manufacture of sulphuric acid."—January 6, 1869.

62. W. T. Waite, Salisbury Square, London, "Improvements in the treatment of saccharine matters."—January 8, 1869.

98. C. J. Günther, Mark Lane, London, "Improvements in salting and preserving meat."—A communication from Baron J. von Liebig, Munich, Bavaria.—January 13, 1869.

230. A. V. Newton, Chancery Lane, "An improvement in fermenting substances and germinating grain and seeds."—A communication from R. d'Heureuse, San Francisco, California, U.S.A.—Jan. 25, 1869.

1278. T. Forster, Streatham, and P. B. Cow, jun., Streatham Common, "Improvements in compounds containing india-rubber, gutta-percha, or ballata, and in the manufacture of such compounds."—April 24, 1869.

106. C. P. Coles, Mountfield, Bonchurch, Isle of Wight, "Improved means of protecting the bottoms of ships, or other submerged structures, from fouling."—Petition recorded January 13, 1869.

130. P. Spence, Newton Heath, Manchester, "Improvements in the production of sulphate of potash for the manufacture of alum."—January 15, 1869.

148. F. Braby, Camberwell, Surrey, "Improvements in the commercial manufacture of sulphate of ammonia."—January 16, 1869.

186. H. A. Bonneville, Paris, "Improvements in the manufacture of illuminating gas, and of sponge, by the action of hydrocarbon liquids, or fluids, on metallic ores, and in the furnaces for melting said sponge and other metals."—A communication from C. J. Caumon, Toulouse, France.—Petition recorded January 20, 1869.

223. W. M. Welling, New York, U.S.A., "Improvements in compositions resembling ivory."—January 25, 1869.

246. C Gil, Boulevard des Capucines, Paris, "Improvements in the manufacture of sugar."—January 26, 1869.

252. T. Vaughan, Middlesborough-on-Tees, Yorkshire, and J. W. Smith, Manchester, "Improvements in treating smoke and soot for the preparation of an article of commerce therefrom."—January 27, 1869.

262. A. C. Pass, Bedminster, Bristol, "Improvements in the method of, and the apparatus for, condensing and purifying metallic and other fumes, vapours, gases, and smoke, and in obtaining oxide of zinc."—January 27, 1869.

287. F. Jay, South Lambeth Road, London, "Improvement in the manufacture of oil paint."—January 29, 1869.

330. C. D. Abel, Southampton Buildings, Chancery Lane, "The production of a new or improved hydraulic cement or artificial stone."—A communication from J. A. Dubus, Rue Aubert St. Denis, near Paris.—February 3, 1869.

355. F. Braby, Camberwell, Surrey, "Improvements in the treatment and utilisation of the waste solution of sulphate of iron, resulting from the cleansing of iron surfaces in the process of galvanising."—February 5, 1869.

376. E. Meldrum, Dechmont, Linlithgow, N.B., "Improvements in the manufacture of paraffin oil."—February 6, 1869.

753. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the preparation of artificial fuel, and in the manufacture of gas and coke therefrom."—A communication from J. M. J. C. Du Lin and J. A. C. d'Almas, Paris.—March 11, 1869.

1260. J. Major and W. Wright, Swallow Street, Middlesex, and G. H. Jones, Alpha Road, Middlesex, "A new or improved manufacture of white lead, and apparatus employed therein."—April 24, 1869.

1409. F. C. Knowles, Lovell Hill, Berks, "A new or improved method of purifying and converting cast-iron into malleable iron, or into steel, and for the making and use of materials and appliances for the same."—May 8, 1869.

1426. W. E. Newton, Chancery Lane, "An improved process and composition for hardening common or grey cast-iron, and for converting articles of iron into steel, or imparting thereto a steely character."—A communication from B. W. Nichols, Canton, Ohio, U.S.A.—May 10, 1869.

1431. H. Bessemer, Cannon Street, London, "Improvements in the manufacture of malleable iron and steel, and in furnaces and apparatus employed for their fusion and treatment."

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1582. H. R. Lumley, St. John's Wood, London, "Improvements in heating and purifying crude iron, and in making steel, and in an apparatus for such purpose."—May 22, 1869.

318. W. J. Palmer and W. P. Goulding, Reading, Berkshire, "Improvements in evaporating and calcining alkaline solutions which have been used to boil vegetable fibres."—Petition recorded February 2, 1869.

362. J. Halford, Kingswinford, Staffordshire, "Improvements in puddling furnaces used in the manufacture of iron, and in other reverberatory furnaces"—February 5, 1869.

419. P. Taysen, Leith, "Improvements in the manufacture of stearic and oleic acids."—A communication from J. C. A. Bock, Copenhagen, Denmark.—February 10, 1869.

460. A. H. Lewis, Fenwick Street, Liverpool, "Improvements in extracting copper from its ores."—A communication from T. S. Hunt, Montreal, and J. Douglas, jr., Quebec, Canada.—February 15, 1869.

510. E. Dorsett, London Street, London, "Improvements in means and apparatus for heating, smelting, and working metals, and in furnaces employed therein, which improvements are also applicable to heating and otherwise operating upon minerals and other substances."—February 19. 1869.

699. J. P. Budd, Ystalyfera, near Swansea, Glamorganshire, "Improvements in the manufacture of iron and steel."—March 8, 1869.

727. G. Spencer, Cannon Street, London, and J. Barker, St. Leonards, Mortlake, Surrey, "Improvements in preserving animal substance, fruits and other substances, made from corn, grain, or other vegetable matter."—March 9, 1869.

1044. W. T. Rickard, Crown Court, Threadneedle Street, London, "Improvements in the preparation of cements."—April 7, 1869.

1418. H. R. Lumley, St. John's Wood, London, "The treatment of molten iron in order to free it from all impurities."—May 10, 1869..

1568. G. Johnston, San Francisco, California, U.S.A., "Improvements in the distillation of spirituous liquors, and in apparatus to be employed therefor."—May 20, 1869.

NOTES AND QUERIES.

Benzoic and Succinic Acids.—The commercial use of both these acids is very limited. Benzoin *resin* is used in perfumery, varnish making, and dyeing; in this latter operation both benzoic and succinic acids are also used and applied to a limited extent as mordants; beside this, both these acids are used in pharmacy, and, as is well known, applied in analytical chemistry, as ammonia salts chiefly; their high price would prevent their very extended use.

Mineralised Manure.—It appears from a short notice in *Les Mondes* chiefly intended *pour prendre date*, that there has been found, in the Department of the Haute-Saône, near Lure, a layer of from 40 to 100 met es thickness of a mineral made up of from 3 to 4 per cent of bituminous oil, 2·8 of nitrate of ammonia, 5·8 of nitrate of potassa 40 of carbonate of lime, 25 of gelatinous silica, 0·5 of oxide of iron, and 0·1 of sulphur. This mineral deposit appears to be the result of the slow decomposition of vegetable and animal matter, especially molluscs, belonging to a former period of animal life on our globe.

Water Saturated with Gypsum.—The result of the analysis, by Dr. F. Goppelsroeder, of a spring water found on the Diirenberg Estate, near Langenbruck in Silesia, gave for the saline matter found in 1000 c.c. of water:—1·636 grms of anhydrous sulphate of lime, 0·185 of sulphate of magnesia, 0·019 of carbonate of lime, 0·024 of carbonate of magnesia, 0·008 of carbonate of protoxide of iron, 0·005 of silica, 0·06 of chlorine (combined with alkalies); moreover, small quantities of alumina, baryta, strontia, ammonia, phosphoric acid, nitric acid and organic matter, which were not quantitatively determined. The solid residue of 1 litre of water, dried at 100° C., amounted to 2·503 grms.

Natural Water Containing Excess of Oxygen.—At Neubourg, Département de l'Eure, France, a spring of mineral water is found, from which a gas is constantly bubbling up and given off in large quantity, which, on analysis, proved to contain 44·6 per cent of oxygen, and 55·4 per cent of nitrogen; the gas causes, just as pure oxygen does, partly extinguished but yet glowing splints of wood to burst into flame. The analysis of the water proved it to contain in 4 litres the following quantities of saline constituents, expressed in gramme weight:

	grm.
Chloride of potassium	0·0096
Phosphate of lime	0·0128
Alumina and peroxide of iron	0 0200
Silica	0·0140
Sulphate of lime	0·0348
Chloride of magnesium	0.0688
Nitrate of magnesia	0·0878
Carbonate of lime	0·7210
	0·9688
Free carbonic acid	0·3284

—*Annuaire Pharmaceutique for* 1868.

Aniline Black.—The best kind of this dye is called in France, *Noir d'Anilin Lucas;* in England it is known as Petersen's aniline black; it is made, by a process kept secret, by M. F. Petersen, at St. Denis, near Paris. It is met with in commerce as a very deep black-coloured fluid, which, for the purposes of calico-printing and dyeing, has only to be thickened with starch paste, imparted to the tissue, and oxidised, to produce the finest deep black velvety-looking dye ever obtained. Among the very large number of prescriptions for manufacturing aniline black we notice Coupler's method, which is the following:—A mixture is made of 175 parts of nitrobenzin, 175 of aniline, 200 of commercial hydrochloric acid, 16 of iron turnings, and 2 of finely divided copper; this mixture is heated for from 6 to 8 hours at from 160° to 200° C., in an inside-enamelled iron-ware distilling apparatus. The operation is finished when a small portion of the mixture, having been previously removed from the apparatus and cooled, can be drawn into a tough thread-like mass, when rapidly pulled between the fore-finger and thumb. The dye produced in this manner is soluble in acids, alcohol, and wood-spirit. When it is intended to apply this substance as a dye, it is dissolved in sulphuric acid, serving as a dye bath, after which the woven tissue, thread, or yarn, has to be bathed in a solution of either an alkali or hyposulphite of soda, in order to fully develop the black dye; without this precaution a black, verging upon violet or blue, is obtained.

Contraction of Caoutchouc by Heat.—It appears that M. Govi, at Turin, has repeated the well-known experiments of Joule and Thomson about the contraction which caoutchouc, after having been previously stretched out, undergoes when heat is applied. The author has found that this contraction only takes place within certain limits of temperature, and that, if a greater degree of heat be applied, the stretched-out caoutchouc, even though by no means exposed to a degree of heat which softens it to a pasty mass, expands and becomes rapidly longer. This substance which has, in some aspects, puzzled philosophers, especially as regards some of its physical properties, has been frequently considered to consist of a kind of solid foam, made up of a large number of small vesicles filled with gas. This theory has been proved to be a reality, since Payen and others have seen these vesicles under the microscope, while M. Grovi has succeeded in expelling a portion of the gas from the vesicles by softening the caoutchouc, by means of oil of turpentine, and withdrawing by means of the vacuum of the air-pump, the ordinary atmospheric pressure. This peculiar kind of constitution of the caoutchouc being admitted, it is easily seen that the vesicles, when that material is stretched, will lengthen in the direction of the stretching force, and contract—become more narrow—in the perpendicular direction to that force. When, under these conditions, the caoutchouc is heated, the gas within the vesicles, while expanding, will have a tendency to return to the spherical shape it possessed before being stretched, and this explains, therefore, the paradox of its becoming shorter while heated; in other words contracting instead of expanding by heat.—*Les Mondes.*

Rendering Walls Impervious to Damp.—I am at present erecting a new laboratory, and am anxious to get the walls, &c., as impervious as possible to damp. Can any of the readers of the Chemical News tell me what agent is the best to use for this purpose on brick, plaster, and cement? A wash of silicate of soda has been recommended, but I fear the effects of efflorescence afterwards. Would a mixture of silicate of soda with some other agent obviate this? I see several makers of soluble glass advertise in your columns: perhaps they might be induced to answer this question.—Builder.

Recovered Grease.—Could any of your readers tell me how to detect recovered grease in tallow?—C. W.

Picrates.—Can any of your correspondents tell me the simplest and cheapest way of making picrate of ammonia and other picrates?—T. E. D.

Scale of Temperatures.—Will any of your numerous correspondents kindly direct me to any good and dependable scale of temperatures at which glasses and metals fuse, comprising all usual silicates of potassa and soda, and such compound metals as have been noted, the object being to obtain a pyrometric gauge for temperatures between 900° and 2000° F.—Alfred Payne.

Colour of Vermilion.—It is a fact well known to artists, that the splendidly bright colour of vermilion (cinnabar, sulphide of mercury) has a tendency, especially if it has been mixed with white-lead, to become blackish brown and very dark coloured in a comparatively short time. This tendency of the vermilion is altogether obviated if, previous to being mixed with oil, it is thoroughly and intimately mingled with about ⅛th of its weight of flowers of sulphur.

Action of Different Bodies on Sulphuretted Hydrogen.—M. Bœttger remarks that oxide of thallium inflames this gas when coming into contact with it; so do pure peroxide of manganese, peroxide of lead, and peroxide of silver obtained galvanically. With binoxide of barium, chlorate of lead, and chlorate of silver, the gas becomes vigorously inflamed; fulminate of silver also inflames the gas, and the salt explodes. Iodide of nitrogen explodes in contact with this gas, which, under certain conditions, is inflamed by gun-cotton.

Picrates.—"T. E. D." is referred to either Watts's "Dictionary of Chemistry," the *Handwörterbuch der Reinen und Angewandten Chemie*, vol. vi., or any treatise on chemistry, wherein he will find the required information, too long for the space at our disposal in Notes and Queries.

Recovered Grease.—We do not quite understand the meaning; for, as long as grease is not saponified, or otherwise altered, or purposely adulterated, so as to become thereby unfit for use, it remains grease to all intents and purposes, and its physical and chemical properties remain then, of course, unaltered.

Scale of Temperatures.—The latest edition of Gehler's extensive *Physikalisches Lexicon;* also the works of Karmarsch, and Prechtl's *Technologische Encyclopedie*, contain what is desired by our correspondent, who will find these works either in the library of the British Museum, or that of the Commissioners of Patents.

Ineradicable Writing.—A French technical paper, specially devoted to the art and science of paper manufacture, states that any alterations or falsifications of writings in ordinary ink may be rendered impossible by passing the paper upon which it is intended to write through a solution of 1 milligram (0·01543 English grain) of gallic acid in as much pure distilled water as will fill to a moderate depth an ordinary soup-plate. After the paper thus prepared has become thoroughly dry, it may be used as ordinary paper for writing, but any attempt made to alter, falsify, or change anything written thereon, will be left perfectly visible, and may thus be readily detected.

New Sulpho-Salts.—Can any one explain the notation and formulæ of Schneider's new sulpho-salts? If the new notation be intended, the nearest approach would be, in old terms,—

			Schneider.
$K8 + Fe_8S_8 =$	K	19·6	24·59
	Fe	37·6	35·19
	S	42·8	40 22
		100·0	100·00

But the Bismuth salt is much more discrepant.—Chemicus.

["Chemicus" is reminded that all formulæ and all cyphers are correctly reproduced from the original papers they are taken from; and that the authors, and not we, are responsible for the formulæ, &c., which we have no right to alter or change.—*Ed.* C. N.]

"*On Employment of Constant Factors in Calculation of Indirect Analysis.*"—The following appears to me to be a more simple and more easily recollected method for determinations by indirect analysis:—Presuming the salt is ascertained to be a mixture of the chlorides of potassium and sodium and the amount of chlorine has been determined, calculate the weight of NaCl corresponding to the weight of chlorine found; then, since for every molecule of NaCl that is replaced by KCl there will be an increase of weight equal to 16 (*i.e.*, the difference between K and Na), the *difference* between the calculated weight of NaCl and the weight of the salt, being due to the extra weight of K over Na, will, if divided by 16, give the number of atoms of Na which are replaced by K in the mixture; and the number of atoms, multiplied by the atomic weight 39·2 will give the weight of potassium, which, together with the weight of chlorine, being deducted from weight of salt, will give the weight of sodium. A general formula may also readily be used for determination of any substance formed by three elements—

Let (*a*) be the combining equivalent of the heavier element;
Let (*b*) be the combining equivalent of the lighter element;
Let (*c*) be the combining equivalent for the determined element.

$$(a^m + b^n + c^{m+n})$$

will then be the formula for any such compound; let it be equal to (x) calculate—

$$(b^{m+n} + c^{m+n})\ ;$$

let it equal (y); then—

$$\frac{x-y}{a-b} \times a$$

will give the weight of (*a*) contained in the substance.—M. P.

Superphosphates.—Probably some of your chemical correspondents would tell me if, in superphosphates, a chemist can say whether it has been made from bone material or mineral phosphate, either wholly or mixed. I am in the way of selling and buying such, and buy according to the quantity of soluble and insoluble phosphates present. I wish to buy nothing but bone material. According to Dr. Anderson and other agricultural chemists, the phosphate in mineral is of much less value than in bone this last season; the phosphate in mineral was sold at 10d. per unit per ton, while that in bone-ash was 1s. 5d. per unit per ton. I buy at the rate given for phosphates in bone-ash. I have sent to a number of chemists for analysis samples of my manure, and get often very irregular results from the same lot; but in no case can I be informed whether the manure has been made from bone-ash wholly, or only partly, and how much of the one and the other. Is this problem within the range of ordinary analysis? If not, what guarantee have farmers that they are not paying for an article they do not get?—A Constant Reader of The Chemical News.

Albumen.—It frequently happens that among the dried albumen met with in commerce a variety is met with which is soluble in water, but not coagulated by the application of heat. Dr. Mounier, at Lyons, has succeeded in preparing this modification, and has studied its properties. When white of eggs is slowly evaporated by exposure to the heat of the sun, or rapidly evaporated to dryness on a water bath, after having been previously exposed to strong daylight for a considerable length of time, a modification of albumen is obtained, non-coagulable by heat. A dilute aqueous solution of this non-coagulable albumen is not precipitated by addition of acetic, formic, or tartaric acid, but the addition of these acids (a few drops) restores its coagulability by heat. In order to restore to 0·20 grm. of this dry albumen dissolved in 10 c.c. of water its coagulability by heat, it was sufficient to add 5 milligrammes of solid crystalline acetic acid, dissolved in 0·5 c.c. of water. If as much ammonia was added as exactly suffices to neutralise the acid, the albumen thereby again lost its property of becoming coagulated by the application of heat.—*Deutsche Industrie Zeitung.*

Rendering Walls Impervious to Damp.—This is not a very simple question; well-built walls of proper construction ought not to be damp: the causes of dampness may be—(1) bad foundation in a wet or ill-drained soil too impervious for water, and the use of unsuitable building materials, *i.e.*, too porous bricks or natural stone; (2) walls may be damp because on being exposed to rain, and made of materials which greedily absorb and retain water, they slowly but surely allow it to evaporate where the heat is greatest, viz., on the inner side; (3) damp walls may be due to the infiltration of water from drains, as well as from improperly-constructed gutters along the roof, and rain-water pipes. Really sound building materials, well-seasoned stone and sound bricks, laid in a proper cement and upon a suitable foundation, concrete if necessary, and application of coal tar or even asphalt, will insure against defects of soil wherein foundation is laid, especially if care be taken about proper drainage pipes. As to covering, coating rather, walls inside with materials to resist damp there are various means at hand. Supposing due care to have been taken in building the wall, and good materials to have been used, it may be coated with a thin layer of good Portland cement, mixed with a little plaster of Paris, and, after this is thoroughly dry, it may be hardened, and rendered impervious to water by painting it with boiled linseed oil and red-lead mixed together. If it is required afterwards to have a kind of stucco laid on, it not being intended to paper the wall, such stucco may be made up—(1) of gypsum, plaster of Paris mixed with a thin glue solution, to which a small quantity of sulphate of zinc has been added, constituting, after drying, a hard surface, which can be rubbed smooth with pumice-stone; (2) or a paint is used made of 50 parts of fine white sand, similar to that used in glass-making, 50 parts of marl, 9 of massicot, litharge, and 9 of red-lead, mixed with 4½ quarts of boiled linseed oil. Water-glass, or silicates of soda or potassa, have not been found to answer well: perhaps Szerelmey's silicate zopissa might answer the purpose.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

*** We shall feel indebted to correspondents who will forward us Reports of Local Meetings of Societies, Chemical Appointments, and any other subjects interesting to the chemical world. We regret that, owing to the increasing popularity and circulation of the Chemical News, and consequent pressure on our space, we are often compelled to delay the publication of long papers. To those correspondents who wish to favour our readers with Notes of New Discoveries, Descriptions of Apparatus, or Answers to Questions, we would especially recommend our Notes and Queries columns.

E. K.—The lecture will be shortly published in our pages. Our publisher will write to you about the volumes of the Chemical News. The acid liquid is probably deliquesced phosphoric acid. We cannot vouch for the statements made by advertisers unless we have personally inspected the goods.

Tyro.—Add ammonium sulphide to the solution; collect, wash, and dry the precipitate, and fuse with a mixture of nitre and carbonate of soda.

H. Kelsoe.—The Adulteration of Food Bill, passed some years ago, is practically inoperative.

X. Q.—Cadmium amalgam is not at all brittle, but is tough, and highly malleable.

Messrs. J. B. and Co.—A letter is waiting for you at our office.

G. N. M.—There is no good description of the battery published. The manufacturer will give you any information you require.

E. K.—The book is excellent; the price a guinea. Thanks for the notes.

Sulphate of Manganese.—No. 494, p. 252 (*Am. Repr., July*, 1869, *page* 51). A letter is waiting for our querist on this subject.

E. H.—Good medicinal carbolic acid will answer the purpose; add it to the water in which the linen is washed, in the proportion of a teaspoonful of the acid to half a gallon of water.

Messrs. Macniven and Cameron, 23, Blair Street, Edinburgh.—We have received the pens, and like them much. The "Waverley" is as pleasant to use as a quill, while the "Owl" answers well for small, fine writing. The "Pickwick" is also good.

B. B.—We did not speak of the original articles contained in the periodical quoted by you, but only to articles abstracted and translated from other periodicals. We find on page 308, a paper originally published in June last; several other abstracts are from papers as old as those published in October last year. We will assume your correction of 1868 for 1858 to be correct; but it must be remembered that we do not, unless in special cases, abstract or mention the abstracts from other foreign sources met with in the periodicals we quote. At page 323 is a paper published a year ago at the time the periodical you allude to was issued.

A. B. E.—Our correspondent will find in No 488, April 9, 1869, p. 178 (*Am. Repr., June*, 1869, *pages* 318, 319), the information he asks for.

Communications have been received from A. Voelcker; E. Kernan; C. Higgins, B.A.; P. M. Muir; S. Dunn; J. Davis (with enclosure); J. Pride; R. R. Tatlock; W. A. Todd; E. C. C. Stanford; F. A. Abel, F.R.S. (with enclosure); F. Jennings; R. D. Grindley; Mawson and Swan; A. Baxter; J. Heywood; Longmans and Co.; Dr. Rohrig; J. Spiller; Dr. E. Fleischer (Dresden); J. Hughes; E. H. von Baumhauer; G. Pearson; H. Yeates; C. Tomlinson, F.R.S.; B. Quaritch; Dr. Adriani; The Royal Institution; E. P. H. Vaughan; A. Clarke; and S. W. Rich; E. H. von Baumhauer; Macniven and Cameron; Sir William Thompson, F.R.S.,; T. Bloxam; E. Kernan; Johnson and Sons; E. Hayes; C. Collins; C. Tomlinson, F.R.S.; C. Williams; A. Payne; R. W. Roberts; H. Fletcher; J. Wallace; E. C. C. Stanford (with enclosure); Mawson and Swan; E. Weston; D. Swan, jun. (with enclosure); H. H. Watson; E. Jones; Dr. R. Angus Smith, F.R.S.; Young and Co.; J. Davis; J. J. Lundy; J. Gregory; J. Riley; W. A. Todd; J. Muspratt and Sons; Kingsbury and Co.; R. D. Grindley; A. Gow (with enclosure); H. Nicol; W. Smith; Evans, Lescher, and Evans; G. G. Walmsley; C. S. Romains; G. W. Bucklyn; Robbins, Lane, and Pinniger; G. W. Buckley; R. Laurie; B. Nightingale; A. S. Herschel; W. Blench; Ritchie and Sons; J. H. Richardson; W. Wotherspoon; A. Wuth; J. Wallace; M. Prentice (with enclosure); H. Bassett; Maclachlan and Stewart; H. Greenwood; J. C. Major; J. Thorn (with enclosure); E. G. Tosh; T. Morson and Son; W. & H. M. Goulding (with enclosure); P. Squire; S. R. Muspratt; A. N. Graham; W. Bailey and Son; J. Cliff; J. Tilley; F. W. Whiffin; H. Cole, C.B.; R. Gregson; J. C. Brough; J. Barclay; J. Jones; Dr. Bedford; E. F. Teschemacher; and J. Denham Smith.

Books Received.—"Spectrum Analysis;" Six Lectures delivered in 1868 before the Society of Apothecaries of London, by Henry E. Roscoe, B.A., Ph.D., F.R.S. With appendices, coloured plates, and illustrations. London: Macmillan and Co. "Archives Néerlandaises des Sciences Exactes et Naturelles, Publiées par La Société Hollandaise des Sciences à Harlem, et Rédigées par E. H. von Baumhauer. La Haye: Martinus Nijhoff. Londres: Trübner and Co.; Williams and Norgate.

AMERICAN SUPPLEMENT.

New York, August, 1869.

A New System of Assay Weights.

The French system of weights, now very generally employed by analytical chemists in this country, leaves nothing to be desired, as far as convenience and simplicity are concerned, except in a few cases where the results of analysis are not reported in percentages. In assaying ores of the precious metals the percentages of gold and silver would entirely fail to convey a clear idea of the value of the ore. The results must be expressed either in troy ounces per ton, or in coin values. As an example, 50 grammes of a gold quartz yielded 0·00475 grammes of gold and 0·00092 grammes of silver; reduced to percentages we should have—

Gold . . . . 0·00950 per cent.
Silver . . . . 0·00185 " "

reduced to troy ounces we have—

Gold . . . . 2·77 ounces per ton of 2,000 lbs.
Silver . . . . 0·54 " " "

or, reduced to coin value, we have—

Gold . . . . $57·25 per ton of 2,000 lbs.
Silver . . . . 0·68 " "

The advantage of the second and third methods of reporting the results are at once apparent.

To obviate the labor and danger of mistake which attend the calculations involved, we made use of the following table:

1 milligramme of gold or silver obtained from

100	grms.	equals	0·2916	troy ounce	in 2,000 lbs.
50	"	"	0·5833	"	" "
25	"	"	1·1666	"	" "
10	"	"	2·9165	"	" "
5	"	"	5·8330	"	" "
2	"	"	14·5825	"	" "

This enabled the assayer to convert his results into troy ounces per ton by a simple multiplication. To simplify this still further, however, we have devised a system similar to those employed by assayers in Germany. We have our *assay ton* for the ore, and our *assay ounce* for the precious metal.

Selecting the milligramme for our assay ounce, the assay ton must be as many milligrammes as there are troy ounces in 2,000 avoirdupois pounds.

$$\frac{2000 \text{ lbs.} \times 7000 \text{ grs.}}{480 \text{ grs.}} = 29{,}166\tfrac{2}{3} \text{ troy ounces in}$$

one ton of 2·000 lbs., 29·1666 grammes, is the assay ton. Every milligramme of gold or silver obtained from this quantity of ore is a troy ounce in 2,000 lbs.

When it is desirable to use a larger quantity of ore, as in assaying poor gold ores, two or four assay tons may be employed, the milligrammes of gold obtained must then be divided by two or four to represent the troy ounces in a ton. For crucible assays of silver ores we use one-third of an assay ton of ore, and multiply the milligrammes of silver by three to give the troy ounces per ton. For scorification assays of silver ores we use one-sixth, one-tenth, or one-twentieth of an assay ton, according to the character of the ore; multiplying the number of milligrammes obtained by six, ten, or twenty, according to the quantity used. Becker & Son now manufacture, at our suggestion, a set of assay weights on this system. The set includes weights of the following denominations:

4	assay	tons,	or 116·6666	grm.
2	"	"	58·3333	"
1	"	"	29·1666	"
½	"	"	9·7222	"
⅛	"	"	4·8611	"
1/10	"	"	2·9166	"
1/20	"	"	1.4583	"

Also the gramme series, from 100 grammes to 0.010 grammes (10 milligrammes) for fluxes and ores of the baser metals. This set of weights is intended for weighing ores and fluxes, and Becker & Son now manufacture a beautiful little balance, called by them "ore-scales," to be used with them, far superior in accuracy, strength, and durability to anything else of the kind, and costing but a very moderate sum. These weights and balances, though designed for ores and fluxes, are sufficiently accurate for the metallic buttons obtained in many assays, as well as for most technical analyses. For gold and silver assays, however, specially the former, the assay balance and fine weights should be employed in weighing the resulting buttons or globules. This system of assay weights has now been in use at the School of Mines of Columbia College for three years, and we think it leaves nothing to be desired in this direction.

Dangerous Kerosene.

Four children were burned to death at Corydon, Ind. on the night of July 3d; the fire is attributed to the explosion of a lamp while the children were all asleep. July 13th, Nora Woolf, of New York, aged 14, was fatally burned by an explosion of kerosene, used for kindling a fire. July 14th, John Stein, of Yonkers, was shockingly burned by the explosion of a kerosene lamp. July 13th, a kerosene lamp expoded at 71 Bayard street, New York. Mrs. Ami Festlonel was burned to death in Baltimore by the explosion of a can of kerosene oil. Mr. Wellington, of Boston, was fearfully burned by the explosion of a lamp containing "lucine oil." The lamp was shattered into more than one hundred pieces. "Lucine oil" is *a light and dangerous naphtha*, one of the most explosive products of petroleum. The East Hampton Rubber Thread Works, and the Valley Pump Co.'s Works were destroyed by fire, July 12th, caused by an explosion of naphtha; loss $140,000. We shall continue to record these shocking casualties, caused by *dangerous kerosene*, till by the passage of suitable laws we are satisfied that the pub-

lic has been properly educated on the subject. *Good kerosene will not explode.*

New Springs at Saratoga and Ballston.

Two new springs have recently been discovered at Saratoga, which very much resemble the famous Congress, and which are situated very near it: the Crystal Spring, owned by Mr. C. R. Brown, proprietor of the Park Place Hotel, and Hathorn's Spring, owned by Mr. H. H. Hathorn, proprietor of the new Congress Hall. The Pavilion and United States springs have been recently retubed, and preparations are now being made to bottle the waters. In Ballston two more artesian wells have been bored; one known as the "Franklin," on a hill, fifty feet above the creek, is owned by Samuel Hides and John Mitchel, the other in the valley, not yet named, is owned by S. B. Conde and J. V. Denton. The waters of these wells very much resemble that of the Artesian Lithia Spring, an analysis of which was given in our last issue (*Am. Repr., page* 54). The waters of all these springs are now undergoing analysis, and we shall soon be able to place the results before our readers.

Petroleum Statistics.

According to the Titusville (Pa.) *Herald*, the production of petroleum in that region has diminished one hundred barrels per day during the past two months. This decrease is caused by the natural falling off in the product of the oil wells having been greater than the additional yield of new and resuscitated wells. The torpedoing of wells resulted less successfully than during the previous month, and very few of the new wells completed were of importance. The total production during the month of June was 301,936 barrels, of 43 gallons each; which is a daily average of 10,064 barrels.

Edward W. Root, who has for several years been in charge of one of the laboratories of the School of Mines of Columbia College, has been appointed Child's Professor of Agricultural Chemistry at Hamilton College.

A New Mineral.

Prof. George J. Brush and John M. Blake have discovered that the dull black crystals which occur in the iron mine at Munroe, in Orange county, N. Y., and which have passed for pyroline, are really a new variety of chrysolite, for which they propose the name hortonolite.

An analysis by Wm. G. Mixter gave—

Silica	33·59	= oxygen		17·91
Ferrous oxide	44·37	"	9·85	
Manganous oxide	4·35	"	0·98	
Magnesia	16·68	"	6·67	17·56
Lime	trace			
Potash	0.39	"	0·06	
Loss by ignition.	0.26			
	99·64			

The July number of *Silliman's Journal* contains a paper on the subject.

Recent Chemical Patents.

Issued July 6, 1869.

92,176.—Method of obtaining Benzole and its Homologues from Coal-Gas. F. Engelhorn, A. Clemm, H. Caro, C. Clemm, Mannheim, Germany.

92,215.—Apparatus for Filtering Liquids under Pressure. T. R. Sinclaire, New York.

92,229.—Process of Treating Vegetable Substances to obtain Fibre. B. C. Tilghman, Philadelphia, Pa.

92,269.—Water-Proof Fabric for the manufacture of Hats and other articles. D. A. Connor, Milford, Conn.

92,292.—Composition for Staining Glass. H. V. Edmond, Norwich, Conn.

92,303.—Papier-Maché Compound. G. F. Gœtze, New York.

92,337.—Nickel-Lined Culinary Vessels. S. C. Moore, Boston, Mass.

92,345.—Mode of Hardening and Working "Ransome Concrete Stone." R. Norris, Jr., Baltimore, Md.

92,358.—Artificial Stone. A. Quesnot, Bloomington, Ill.

92,390.—Concrete Pavement. H. B. Steele, Winchester, Conn.

92,391.—Apparatus for Generating and Carburetting Gas for Lighting Railroad Cars. J. H. Steiner, St. Louis, Mo.

92,405.—Manufacture of Hydrate of Magnesia. Carl Wandel, Waldau, Germany, assignor to F. O. Matthiessen and W. A. Wiechers, New York.

92,406.—Manufacture of Granulated Sugar. Carl Wandel, Waldau, Germany, assignor to F. O. Matthiessen and W. A. Wiechers, New York.

Reissues.

11,608, reissue 3,531.—Manufacture of India Rubber. J. L. Carew, Norwich, Conn., assignee of C. Swan, executor of D. Hayward, deceased.

87,075, reissue 3,534.—Process of Repairing Crucibles. W. F. Sherman, Bucksport, Me.

75,656, reissue 3,540.—Manufacture of Crushed Sugar. C. Spreckels, San Francisco, Cal.

Issued July 13, 1869.

92,416.—Finishing and Dressing Sheep-Skins for Leather. R. Andrews, Milwaukee, Wis.

92,427.—Manufacture of Tobacco Paper. P. M. Consuegra and R. Antiguedad, New York.

92,452.—Process for Coating and Beautifying the Surface of Billiard-Balls, Knife-Handles, &c. J. W. Hyatt, Jr., Albany, N. Y.

92,455.—Apparatus for Concentrating Extracts of Bark and other Liquids. T. W. Johnson, New York.

92,465.—Apparatus for Depurating Liquids. W. Needham and J. Kite, Vauxhall, England.

92,477.—Still for Alcoholic Spirits. W. and G. W. Robson, Cincinnati, Ohio.

92,615.—Atmospheric Tanning Apparatus. J. E. Kauffelt, Shrewsbury. Pa.

92,633.—Apparatus for Ageing Spirits. E. L. Morse, St. Louis, Mo.

92,635.—Carburetter for Air and Gas. W. J. Nichols, Buffalo, N. Y.

92,640.—Process of Purifying Alcohol and other Spirits. C. C. Parsons, New York.

92,651.—German Erasive Soap. G. Sanger, Beloit, Wis.

92,652.—Chemical Olive Soap. G. Sanger, Beloit, Wis.

92,653.—Combined Scouring and Fulling Soap. G. Sanger, Beloit, Wis.

92,654.—Detersive Soap. G. Sanger, Beloit, Wis.

92,655.—"Fulling Soap." G. Sanger, Beloit, Wis.

92,656.—Process for Refining Tallow. G. Sanger, Beloit, Wis.

92,667.—Manufacture of Iron. D. Stewart, Kittanning, Pa.

92,683.—Manufacture of Glue from the Pith of Horns. J. Windward, East Cambridge, Mass.

92,685.—Apparatus for Rectifying and Flavoring Spirits. L. Wolff, Chicago, Ill.

92,687.—Steam Petroleum-Gas Generating Apparatus. R. M. Whipple and A. I. Ambler, Chicago, Ill.

Reissues.

15,838, reissue 3,546.—Apparatus for Generating Carbonic Acid. J. F. Boyntory, Syracuse, N. Y.

72,335, reissue 3,553.—Manufacture of Iron. D. Stewart, Kittanning, Pa.

Issued July 20, 1869.

92,736.—Process and Apparatus for Utilizing the Waste Coal of Mines. T. M. Mitchell, Philadelphia, Pa.

92,744.—Fertilizer from Seaweed. J. G. Nickerson, Boston, Mass.

92,751.—Treating and Revivifying Bone-Black. J. Rogers and L. Reid, Brooklyn, N. Y.

92,757.—Composition for Preventing the Fouling of Ships' Bottoms. R. Sim, Naples.

92,763.—Manufacture of Rubber Balls. J. H. Tuttle, East Hampton, Mass.

92,764.—Process of Treating Vulcanized Rubber, Thread Waste. J. H. Tuttle, East Hampton, Mass.

92,810.—Fertilizer. R. Fish, Washington, D. C.

92,816.—Manufacture of White Lead. J. M. Gattman, New York.

92,836.—Manufacture of Photographic Pictures. J. R. Johnson, London, Eng.

92,855.—Washing and Cleansing Fluid. F. F. N. Marais, New York.

92,875.—Composition of Matter to be used in the Process of Restoring Steel. B. W. Nichols, Canton, Ohio.

92,876.—Converting Articles of Cast Iron into Steel. B. W. Nichols, Canton, Ohio.

92,892.—Hydrogen, Generator and Carburetter. B. Sloper, St. Louis, Mo.

92,894.—Manufacture of Wrought Iron and Steel direct from the Ore. G. H. Smith, New York.

92,901.—Mashing Grain for Distillation. M. Thompson, St. Louis, Mo.

92,924.—Compound Oil for Coating Leather and Metals. W. K. Wyckoff, Ripon, Wis.

Issued July 27, 1869.

92,932.—Sugar-Boiling Apparatus. M. Bonnin and C. Escudier, New Iberia, La.

92,934.—Method of Preserving the Aromatic Principle of Hops. E. D. Brainard, Albany, N. Y.

92,937.—Medical Compound. T. J. Butcher, Wenona Station, Ill.

92,941.—Condenser for Stills. T. J. Dean, St. Louis, Mo.

92,943.—Machine for Generating and Carburetting Gas. C. F. Dunderdale, New York.

92,981.—Method of Extracting Iron and other Oxides from Clay, Porcelain-earth, &c. W. J. Lynd, Golden City, Colorado Ter.

92,993.—Composition for Curing Corns. G. Oakley, Quincy, Ill.

92,998.—Zincking Iron. J. H. Peake, Washington, D. C.

93,002.—Finishing Split Leather. J. Putnam, Danvers, Mass.

93,012.—Method of Manufacturing Vinegar. F. Schleifer, San Francisco, Cal.

93,018.—Composition for Pavements, Roofing, &c. H. Staples, Nashua, N. H.

93,044.—Compound for Destroying Insects. B. Best, Dayton, Ohio.

93,066.—Apparatus and Process for the Manufacture of Salt. T. A. Davis, Watertown, N. Y.

93,072.—Apparatus for Evaporating Ammoniacal and other Liquids. L. S. Fales. New York, N. Y.

93,075.—Manufacture from Bananas and Plantains. T. Fry, New Orleans, La.

93,086.—Composition Dental Plate. A. Hill, Norwalk, Conn.

93,099.—Apparatus for Making Bromine. H. Lerner, Pomeroy, Ohio.

93,102.—Compound for Rendering Fabrics Water-repellant. R. O. Lowrey, Salem, N. Y.

93,105.—Hydrocarbon Burner. E. P. McCarthy, San Francisco, Cal.

93,113.—Method of Exploding Nitro-Glycerine. G. M. Mowbray, Titusville, Pa.

93,127.—Process of Purifying and Refining Alcoholic Liquids. F. Schleifer, San Francisco, Cal.

92,131.—Preparation of Iron for Medical Purposes. John E. Siebel, Chicago, Ill.

93,143.—Liniment. W. H. Wallack, Corunna, Ind.

93,155.—Manufacture of Iron and Steel. J. J. Johnston, Alleghany City, Pa.

NEW PUBLICATIONS.

The Adulteration of Liquors; with a Description of the Poisons used in their Manufacture. By Rev. James B. Dunn. Prize Essay. National Temperance Society.

We have rarely seen so complete an assortment of misstatements and gross exaggerations in twenty-four pages All the sins, real and imaginary, of the brewers, the vintners, the distillers, and the publicans, from the "time of Homer" down to date, are here charged upon the present generation. The absurd quackery of the "Ohio Inspector," and the strychnine joke of the French professor, appear here as grim truth to terrify the toper—who, by the way, will not believe a word Mr. Dunn has written, for he knows whiskey is not all oil of vitriol and strychnine, having drunk it for years without suffering from corrosion or opisthotonus. We should be sorry to believe that the good cause of temperance needed any such assistance as the author of the prize essay offers.

The Journal of Applied Chemistry.

This very inviting paper is published simultaneously at New York, Boston, and Philadelphia, by Dexter & Co. It is now in its fourth year, and is doing an excellent work in making chemical science more popular. Within a few months its character has been greatly improved by the addition to the editorial staff of Prof. C. A. Joy, who possesses the very desirable talent of being able to present the truths of science in the most enticing form, freed from all the forbidding technicalities. The columns of the Journal are also enriched by excellent articles from the pens of Dr. W. A. Wetherbee and Dr. Adolph Ott. It is rather a new thing in this country to have papers devoted to popularizing science edited by really scientific men.

Report on Commercial Fertilizers, made by Prof. S. W. Johnson to the Sec. Conn. Board of Agriculture.

This paper contains careful analyses of several of the fertilizers supplied to Connecticut farmers, and also gives the prices which the farmer can afford to pay for each. Furnishing this kind of reliable, money-saving information to the farmers is not a new idea with Prof. Johnson, as he has for several years been able, by his published analyses, to practically exclude the spurious fertilizers from the State. Pulverized oyster-shells do not find a ready market at fancy prices where his reports circulate. It is surprising that every State in the Union does not employ a chemist to perform this duty for the public which Prof. Johnson has performed in Connecticut. The amount saved to the farmers would be enormous.

The American Journal of Science and Arts for July contains the following articles specially interesting to chemists: 1. Notice of the Life and Labors of Charles Grafton Page, the Electrician, for many years Examiner in the U. S. Patent Office. 2. On the Effect of Atmospheric Air, when mixed with Gas, in Reducing its Illuminating Power. By B. Silliman and Henry Wurtz. 3. A Qualitative Separation of Cobalt and Nickel. By F. W. Clarke. 4. Note on Wollongongite. By B. Silliman. 5. On the Estimation of Carbonic Acid. By S. W. Johnson.

Bunsen's Flame Reactions.—Translated by Prof. Chas. F. Himes, Ph.D. 8vo, pp. 30.

This is an excellent translation of the important article of Bunsen, in which a new system of Qualitative Analysis is developed; in which the flame of the Bunsen gas-burner is substituted for the blow-pipe. By means of a few simple reagents and utensils the most striking results are obtained, with extremely minute quantities of material. This is another of those extremely beautiful inventions of Bunsen, to whom the chemical world is already so much indebted.

The Determination of Carbonic Acid.

Prof. S W. Johnson presents in the July number of the *American Journal of Science* a description of the apparatus and process which he has devised for determining carbonic acid. The carbonic acid is determined by the loss of weight experienced by the apparatus on the expulsion of the acid from its compound. It is not easy, however, to completely remove the acid without at the same time losing some moisture. Prof. Johnson makes a radical improvement on the old process, by filling the charged apparatus with carbonic acid gas, then decomposing the substance to be analyzed, by causing the acid to flow upon it. As soon as the disengagement of gas ceases, the apparatus, still filled with carbonic acid gas, is weighed again. In this manner all aspiration is done away with, and the desiccating material has simply to dry the gas yielded by the substance under analysis. The results quoted are very accurate.

A Qualitative Separation of Cobalt and Nickel. By F. W. Clarke, S.B., of Cornell University (*Sill. Am. J. Sci.*).

Mr. Clarke finds that the different properties of the ferricyanides of cobalt and nickel afford an easy means of distinguishing between these metals. As is well known, ferricyanide of potassium precipitates cobalt and nickel from their solutions. The cobalt precipitate is of a deep reddish brown color, while the nickel compound is of a dirty yellowish brown. The ferricyanide of nickel dissolves with the greatest ease in ammonia or water, or in solution of cyanide of potassium; while the corresponding cobalt compound is absolutely insoluble in either. The previous presence of ammonia water or cyanide of potassium entirely prevents the precipitation of the cobalt by the ferricyanide.

Mr. Clarke applies his test as follows: To the slightly acid solution of the two metals he first adds an excess of chloride of ammonium. This causes the cobalt precipitate, which would otherwise run through the filter, to fall in a denser state. He then adds the ferricyanide of potassium till the precipitation is complete, and afterwards agitates with a considerable excess of ammonia. The cobalt is completely precipitated, while the nickel may be separated from the filtrate by sulphide of ammonium.

BREVITIES.

Mr. E. Seymour has established a mineral agency at No. 52 Beekman street, New York, where mineral collectors will find a tolerably complete assortment of specimens at reasonable prices.

Dr. James P. Kimball, the geologist, has recently returned from Mexico, where he has spent considerable time examining the silver mines of Chihuahua. He gives the most astonishing accounts of the quantities of silver which have been already taken out of the mines by the Spaniards and Mexicans. As modern machinery has not yet been introduced, the mines have not been carried to any great depth, the workings having been confined to the zone above the water, without even penetrating the sulphurets. So there is every reason for supposing that untold quantities of silver await the skilful miners who shall introduce good pumps and systematic mining.

Prof. Raphael Pumpelly, of the Harvard Mining School, is travelling with his students among the copper and iron mines of Lake Superior.

Out of Twenty-one specimens of Kerosene Oil inspected by the New Haven, Conn., Fire-Marshal, only five were found to be up to the standard fixed by law.

Poisoning by Cyanide of Potassium.—Mr. Frederich Wettergreen, of 219 Fifth street, who died at his boarding house under suspicious circumstances, was found to have been poisoned by cyanide of potassium. The contents of the stomach were submitted to analysis in the editor's laboratory.

Impure Water.—A boy was poisoned at Farmington, Me., by drinking water from a well which, in consequence of its foulness, was not used by the family. Typhoid fevers and other very serious diseases often result from the infiltration of very small quantities of sewerage into wells. The cholera is often communicated at considerable distances by this means; whole families, and even neighborhoods, are sometimes afflicted with diseases which are ultimately traced to foul water.

Mr. Bayard Taylor has accepted a non-resident professorship in Cornell University, and will begin next spring the delivery of a series of lectures.

Prof. J. D. Whitney, the State Geologist of California, and Professor of Geology at the Harvard Mining School, is travelling in the West with a party of students.

Naphtha for Kerosene.—A man in Boston has been prosecuted for violating a law made by the last legislature, which provides that "no person shall sell naphtha under any assumed name, under penalty of one hundred dollars fine, and one month's imprisonment, either or both."

The men who sell the "American Liquid Safety Gas" would fare hard in the Bay State, as this is simply a highly explosive naphtha.

Prof. George F. Barker, of the Yale Medical School, is going to Europe to spend a year or two.

Thomas M. Drown, M.D., has been appointed instructor in Metallurgy, and William H. Pettee, instructor in Mining, in the School of Mining and Practical Geology at Harvard University.

Messrs. Schultz and Warker have erected a beautiful kiosk of Moorish architecture, handsomely decorated, in the Central Park, between the lake and the green, where their various mineral waters are supplied to visitors. The waters are all drawn from glass reservoirs through silver or block-tin tubes, so no one runs any risk of lead poisoning in drinking them.

Hippophagy.—During the second quarter of the present year the city of Paris has consumed 605 horses, or about 276,000 pounds net of horseflesh for the three months. A few mules and donkeys are included in the quantity, but the exact number is not specified.

The Presidency of the College of New York, made vacant by the retirement of Professor Horace Webster, has been accepted by Gen. Alexander S. Webb, a son of Gen. James Watson Webb. He graduated from West Point in the class of 1855, with the commission of brevet second lieutenant of the Fourth Artillery.

The Refrigerating Meat Expedition.—The steamship *William Taber* sailed from this port on Saturday for Galveston, purposing to bring back to the New York market a cargo of fresh beef slaughtered in Texas, and preserved throughout the voyage in the hold of the vessel by the refrigerating process. It is expected that the trip will require from thirty to forty-five days, dependent on consequences hereafter to be determined.—*New York Herald, July 27.*

Earth Closets.—The War Department has under consideration the proposed use of a system of earth closets at barracks and other military establishments. The matter is now undergoing an examination in the Bureau of Engineers, and the probability is that it will meet with a favorable report.

Professor Charles A. Aiken, of Princeton College, has been elected President of Union College at Schenectady.

Brandy from Lichens.—Experiments lately made in Sweden on a large scale, upon the production of brandy from lichens, and especially from the reindeer moss, have, it is said, proved so successful as to warrant the practical application of the process.

A New Locality of Franklinite; by W. A. Fonda.—A vein of franklinite has been opened at Centreville, five miles above Paterson, on the side of "Second Mountain." The ore has the same general characteristics with that obtained from Stirling Hill and Franklin Furnace mines. The gauque is rhodonite, and calc-spar in some specimens.—*Sill. Am. J. Sci.*

Prof. E. W. Root has discovered acicular crystals of millerite, sulphuret of nickel, in cavities with spathic iron crystals, in the gneiss of New York Island, at the corner of Fifty-seventh street and Broadway. This rare mineral occurs here in exactly the same form, of acicular tufts, as at Antwerp, Jefferson Co., N. Y.

Alcohol from Garbage.—A company has been formed in Chicago, and will be soon in operation, for distilling alcohol and extracting soap grease from ordinary city garbage. The process is a patented one, and consists in taking the garbage just as it is hauled off in the city carts, dumping it into tight tanks, and boiling six hours at a temperature of 212 degrees. This dissolves the whole mass, which is run into fermenting tubs and worked with yeast. The soap grease and impurities rise to the top of the tubs, and are skimmed off, and the residuum is distilled in the regular way. It is estimated that each barrel of garbage will yield three pounds of soap grease and four gallons of proof spirits. The soap grease is, of course, as good as any other, but the alcohol betrays its origin by an odor which requires further processes for its removal. For many uses, however, it is as good as that derived from grain or molasses, and, if its distillation is not too costly, will yield a considerable profit.—*Sun, July 22,* 1869.

The New Paper for Government Securitifs.—Secretary Boutwell has notified the public that by authority of law he has adopted a distinctive paper, which will hereafter be used until otherwise ordered, for all obligations and other securities of the United States. One of its peculiarities is the introduction of colored silk, cotton, and other fibrous materials into the body of the paper while in the process of manufacture. By the law of the United States it is made a felony, subjecting the convicted offender to a maximum fine of five thousand dollars, or a maximum imprisonment, with hard labor, for fifteen years, or both, at the discretion of the court, for any person to have or retain in his possession or custody any paper adapted to the making of such obligations or securities, and similar to that designated by the Secretary of the Treasury or some other proper officer of the United States. The new national currency has done much to reduce counterfeiting, and it is to be hoped that the effect of Mr. Boutwell's new order will be to abolish it altogether.—*Herald, July 23,* 1869.

AMERICAN DRUGGISTS' PRICE-CURRENT—NEW YORK.—JOBBERS' PRICES.

DRUGS AND CHEMICALS.

Aceton	per oz	to		35
Acid, Acetic, No. 8	per lb	to		18
sp. gr. 1,047 U.S.P.	per lb	to		28
Chemically Pure	per lb	to		55
Glacial	per lb	to	1	60
Benzoic, German	per oz	to		30
Boracic, pure	per lb	to		85
Citric	per lb	to	1	20
Fluoric, 1 lb bottles	per lb	to	2	30
Formic	per lb	to	3	00
Gallic	per lb	to	3	25
Hydrophosphorous	per lb	to	4	25
Lactic	per lb	to	4	25
Muriatic, 18 degrees	per lb	to		5
chemical pure	per lb	to		35
Nitric, 38 degrees	per lb	to		15
chemical pure	per lb	to		38
Oxalic, patent	per lb	to		35
Phosphoric, glacial	per lb	to	3	00
Prussic	per oz	8 to		9
Sulphuric	per lb	4 to		5
chemical pure	per lb	to		50
Valerian	per oz	to	1	40
Tartaric, powdered	per lb	to		84
Aconite Leaves	per lb	to		28
Aconitia	per dr	to	5	00
Agaric Alba	per lb	to		80
Alcohol, 95 per ct	per gal	to	2	40
Aloes, Cape, powdered	per lb	to		36
Socotrine, powdered	per lb	to	1	15
Alum, Roman	per lb	to		11
lump	per lb	to		4½
Ambergris, gray	per oz	to	14	00
Ammonia Carbonate, bulk	per lb	to		24
in jars	per lb	to		25
Muriate	per lb	to		17
Ammonia Aqua, 20 degrees	per lb	to		12
26 degrees	per lb	to		22
Hypophosphite	per lb	to	4	00
Oxalate	per lb	to	2	00
Phosphate	per lb	to	2	00
Sulphate	per lb	to		10
Ammonium Valerian. Crystals	per oz	to	1	30
Ammonium Bromide	per lb	to		
Hydrosulphuret	per lb	to		75
Iodide	per lb	to	8	50
Amygdalin	per oz	to	3	75
Antimony and Potass	per lb	to	1	10
Butter	per lb	to		30
Arnica Leaves	per lb	to		20
Arrow Root, Bermuda	per lb	to		45
St. Vincent	per lb	to		18
Arsenic, white powdered	per lb	8 to		10
red pulv	per lb	to		35
red. lump	per lb	to		20
Arsenic Solution, Fowler's	per lb	to		17
Iodide	per oz	to		90
Sol., Donovan's	per lb	to		33
Asbestos	per lb	to		15
Asparagin	per oz	to	3	50
Atropia	per dr	to	3	50
Sulphate	per dr	to	3	00
Valerian	per dr	to	4	50
Balsam Fir	per gal	to	4	25
Copaiva	per lb	to	1	10
Peruvian	per lb	to	6	00
Tolu, true	per lb	to	1	35
Barbadoes Tar	per lb	to		12½
Bark, Elm	per lb	18 to		20
Bark, Calisaya, quill	per lb	to	1	65
Red, quill	per lb	to	1	85
Pitayo	per lb	to		80
Cascarilla	per lb	to		80
Mezereon	per lb	to		28
Sassafras	per lb	to		10
Baryta Muriate	per lb	to		80
Nitrate	per lb	to		40
Bay Rum	per gal	to	3	75
Bebeerin, pure	per oz	to	5	50
Sulphate	per oz	to	3	50
Belladonna Leaves	per lb	to		25
Bicarbonate Soda	per lb	to		7
Bichromate Potash	per lb	to		23
Bismuth Metallic	per lb	to	8	50
and Ammonia Citrate soluble	per oz	to		90
and Ammonia Citrate Solution	per lb	to	1	30
Oxychloride	per lb	to	7	25
Subcarbon	per lb	to	8	25
Sub-Nitrate	per lb	to	7	50
Tannate	per oz	to	1	50
Valerianate	per oz	to	2	40
Black Drops	per lb	to	4	75
Blue Mass	per lb	to		58
Bole, Armenia, true	per lb	to		10
Borax, refined	per lb	to		40
Brimstone, roll	per lb	to		5
Bromine	per lb	to	3	00
Brucia	per oz	to	3	75
Buchu Leaves, long	per lb	to		62
short	per lb	to		38
Burgundy Pitch, true	per lb	to		15
Cadmium, Bromide	per oz	to		50
Iodide	per oz	to		65
Metallic	per lb	to	4	40
Sulphate	per lb	to	7	50
Caffeine	per oz	to	9	00
Calcium Chloride	per lb	to		90
Iodide	per lb	to	8	50
Calisaya Bark, Milhau's Original Elixir of	per doz	to	11	00
" " "	per gross	to	120	00
Calisaya Bark, Milhau's Chalybeate Elix. of	per doz	to	11	00
" " "	per gross	to	120	00
Calomel, Hydrosub	per lb	to	1	00
Camphor, Refined	per lb	to	1	05
Cannella Alba	per lb	to		30
Cantharides, powdered	per lb	to	2	45
Carbolic Acid crystals	per oz	to		17
" " solution	per lb	60 to		85
" " " common	per lb	to		35
Carbon Bi-Sulphuret	per lb	to		42
Cascarilla Bark	per lb	to		28
Cassia Buds	per lb	to	1	15
Castor Oil	per gal	to	3	25
Caustic Soda	per lb	to		9
Centaury Minor	per lb	to		38
Cerium, Oxalate	per oz	to	1	15
Nitrate	per oz	to	1	60
Chalk Precip., English	per lb	to		23
Cherry Laurel Water	per lb	to		58
Chlorate Potass, English	per lb	to		50
Chloride Lime	per lb	to		8
Chloroform	per lb	to	1	35
Cinnamon, Ceylon, true	per lb	to	1	75
Citrine Ointment	per lb	to		58
Civet	per oz	to	5	50
Cobalt	per lb	to		26
Cocculus Indicus	per lb	to		36
Cocoa Butter	per lb	to	1	00
Codeine	per dr	to	2	50
Cod Liver Oil	per gal	to	2	25
Cod Liver Oil, ("Shore Oil")	per gal	to	2	15
Cod Liver Oil, J. C. Baker & Co.'s	per doz	to	8	00
" " "	per gross	to	90	00
" " " .5 gross,	per gr	to	87	00
Cod Liver Oil, Hazard & Caswell's	per doz	to	7	50
" " "	per gr	to	90	00
Cod Liver Oil, Milhau's Golden	per doz	to	7	00
" Milhau's Etherized	per gross	to	78	00
Cod Liver Oil, Milhau's, with the Hypophosphite of Lime	per doz	to	7	50
	per gross	to	84	00
Collodion	per lb	to	1	65
Cantharidal	per doz	to	4	50
Colocynth, powdered	per lb	to		75
Confectio Rosæ	per lb	to		48
Sennæ	per lb	to		48
Conium Leaves	per lb	to		25
Conlin	per oz	to	7	50
Copper Ammoniated	per lb	to	1	20
Black Oxide	per lb	to	2	20
Carbonate	per lb	to	2	20
Sulphate, pure	per lb	to		38
Copperas	per lb	to		4
Corrosive Sublimate	per lb	to	1	00
Cream Tartar, powdered, pure	per lb	to		50
Cubebs	per lb	to		33
Cubebin	per dr	to		25
Cuttlefish Bone	per lb	to		28
Digitalis Herb	per lb	to		18
Digitaline	per dr	to	3	65
Dover's Powder	per lb	to	3	00
Dragon's Blood, mass	per lb	to	1	00
reeds	per lb	to	1	10
Dulcamara Stems	per lb	to		18
Emetine	per oz	to	3	65
Emery Corn	per lb	to		11
Flour	per lb	to		8
Epsom Salts	per lb	to		4½
Ergot, new	per lb	to	1	30
Ergotine	per oz	to	1	15
Ether, Acetic	per lb	to		80
Butyric, concentrated	per lb	to	4	00
Butyraceous	per lb	to	1	75
Chloric	per lb	to		85
concentrated	per lb	to	1	50
Formic	per lb	to	4	00
Sulphuric	per lb	to		75
washed	per lb	to		80
concentrated	per lb	to		95
Extr. Jockey Club, Chiris	per lb	to	3	65
Extr. Ess. Bouquet, Chiris	per lb	to	3	75
Extr Banana, superior	per lb	to	1	25
Extr. Orange, superior	per lb	to	1	25
Fluor Spar	per lb	to		16
Flowers, Althea	per lb	to		42
Arnica	per lb	to		22
Borrage	per lb	to		95
Chamomile, German	per lb	to		40
Chamomile, Roman, 1867	per lb	to		36
Lavender	per lb	to		9
Malva, large	per lb	to		40
small	per lb	to		45

Flowers, Rosemary	per lb		to	70
Tiliae	per lb		to	70
Violet	per lb		to	68
Fusel Oil, purified	per lb		to	2 00
Ferro - Phosphorated Elixir of Calisaya	per doz		to	12 00
Bark, Hazard & Caswell's,	per grs		to	144 00
Gamboge	per lb		to	1 30
Gelatine French Pink	per lb		to	1 45
Gelatine, White French	per lb	85	to	1 00
Cox's	per doz		to	2 50
Ginger, Jamaica, bleached	per lb		to	30
Ginseng	per lb		to	85
Glauber Salts	per lb	3	to	4
Glycerine, common	per lb		to	35
concentrated	per lb		to	50
"Bowers"	per lb		to	80
"Price's"	per lb		to	1 15
Glycerole Hypophosphite	per lb		to	1 75
Grains D'Ambrette	per lb		to	60
Paradise	per lb		to	30
Gum Acroides	per lb		to	24
Amber	per lb		to	50
Ammoniac	per lb		to	60
Arabic, Turkey, sorts	per lb		to	55
1st picked, Trieste	per lb		to	95
2d " "	per lb		to	75
3d " "	per lb	55	to	60
Barbary	per lb		to	40
Assafœtida	per lb	65	to	70
Benzoin, common	per lb		to	80
prime	per lb		to	90
white marbled	per lb		to	1 00
Copal, Accra	per lb		to	
Benguela	per lb		to	30
Kowrie	per lb		to	45
Damar, Batavia	per lb		to	60
Singapore	per lb		to	55
Elemi, Aromatic	per lb		to	55
Euphorbium	per lb		to	25
Galbanum	per lb		to	1 00
strained	per lb		to	1 25
Gedda	per lb		to	30
Guaiacum	per lb	50	to	60
strained	per lb		to	60
Kino	per lb		to	65
Mastic	per lb		to	4 25
Myrrh, Turkey, powdered	per lb		to	70
Olibanum	per lb		to	30
tears	per lb		to	40
Sandarac	per lb		to	65
Shellac, Campbell's D. C	per lb		to	55
Garnet	per lb		to	52
No. 2	per lb		to	45
Native	per lb		to	45
Senegal	per lb		to	50
Tragacanth, common	per lb		to	50
flake	per lb	1 80	to	1 50
flaky sorts	per lb		to	60
Harlem Oil, Dutch	per doz		to	50
Hoffman's Anodyne	per lb		to	48
Hydriodate Potash, Atkinson's	per lb		to	5 25
Conrad's	per lb		to	5 10
Hyoscyami Leaves	per lb		to	26
Hypophosphite Ammon	per lb		to	3 60
Iron	per lb		to	8 25
Lime	per lb		to	3 50
Manganese	per lb		to	14 00
Potash	per lb		to	3 50
Soda	per lb		to	3 50
Iceland Moss	per lb		to	10
Indian Hemp, true	per lb		to	1 60
Insect Powder, true	per lb		to	1 10
Iodine, Resublimed	per lb		to	6 75
Crude, in bulk	per lb		to	6 50
Irish Moss	per lb		to	10
Iron, Alum	per lb		to	1 60
by Hydrogen	per lb		to	2 50
Carb. Proto	per lb		to	45
Precip	per lb		to	25
Citrate and Ammonia	per lb		to	1 45
Magnesia	per lb		to	1 35
Quiniæ	per lb		to	10 00
Strychnine	per lb	10 00	to	12 50
Hypophosphite	per lb	8 40	to	8 50
Iodide	per lb		to	8 25
Syrup	per lb		to	80
Lactate	per lb		to	8 25
Phosphate, Precipitate	per lb		to	67
Pyrophosphate	per lb		to	1 85
Syrup	per lb		to	65
Sesquichloride	per lb		to	1 45
Sol	per lb		to	60
Sesquinitrate	per lb		to	44
Subsulphate	per lb		to	1 70
Sulphate, pure	per lb		to	9
Exsiccat	per lb		to	17
Sulphuret	per lb		to	31½
Superphosphate Syrup	per lb		to	65
Tannate	per lb		to	6 60
India Ink	per lb		to	1 75
Isinglass, American	per lb		to	1 35
Russian, true	per lb		to	6 50
Juniper Berries	per lb		to	6
Juniper Tar Soap, Hazard & Caswell's	per doz		to	3 75
Kreosote, white	per lb		to	1 15
Lactucarium	per oz		to	75
Lead Acetate, pure	per lb		to	90
Licorice Paste, solid	per lb		to	40
Sicily	per lb		to	30
Calabria	per lb		to	44
Imitation	per lb		to	37
Barracco	per lb		to	43
P. S	per lb		to	44
Lime, Carbonate, Precipitate	per lb		to	22
Hypophosphite	per lb		to	3 75
Iodide	per lb		to	8 50
Phosphate, Precipitate	per lb		to	40
Sulphite	per lb		to	31
Lime Juice	per gal		to	1 50
Lint, Taylor's	per lb		to	1 80
Lapis Calaminaris	per lb		to	8
Laurel Berries	per lb		to	12
Leaves	per lb		to	12
Liquid Styrax	per lb		to	60
Long Pepper	per lb		to	90
Lunar Caustic, pure	per oz		to	1 80
67 per cent., N. S	per oz		to	90
Lycopodium	per lb		to	60
Magnesia Carbonate	per lb		to	42
Calcined	per lb	95	to	1 20
ponderous	per lb		to	1 80
Citrate	per lb		to	1 75
Sulphite	per lb		to	1 20
Manganese, powdered	per lb		to	8
Saxony	per lb		to	12
Manna, small flake, '68	per lb		to	1 75
large flake, '67	per lb		to	2 25
sorts, new	per lb		to	1 30
Matico Leaves, true	per lb		to	50
Mercury	per lb		to	90
cum Creta	per lb		to	56
Magnesia	per lb		to	1 22
Cyanuret	per lb		to	5 80
Sulphuret	per lb		to	80
Mercurial Ointment (⅓M)	per lb		to	70
(⅔M)	per lb		to	58
Morphia Sulphate	per oz	10 50	to	11 00
Acetate	per oz	10 50	to	11 00
Muriate	per oz	10 50	to	11 00
Valerianate	per oz		to	13 00
Musk, true	per oz		to	16 00
in grain true	per oz		to	32 00
Nux Vomica	per lb		to	14
Oil, Amber, Crude	per lb		to	60
Almonds (Expressed) Allen's	per lb		to	90
Essential, Allen's	per lb		to	24 00
Anise	per lb		to	4 25
Bergamot	per lb	6 00	to	7 00
FF, new crop	per lb		to	6 50
Bergamot, Donner's	per lb		to	7 00
Bergamot,—Sanderson's	per lb		to	7 50
Cade	per lb		to	1 00
Cajeput	per lb		to	2 00
Camphor	per lb		to	1 75
Caraway	per lb		to	2 75
Seed	per lb		to	5 50
Cassia	per lb		to	4 00
Cinnamon, true	per oz		to	1 25
Citronella, prime	per lb		to	2 50
Winter's	per lb		to	2 90
Copaiva	per lb		to	3 00
Croton	per lb		to	3 50
Cubebs	per lb		to	4 00
Cummin	per lb		to	10 00
Fennel	per lb		to	3 00
Geranium	per lb	12 00	to	22 00
Chiris	per lb		to	18 00
Prepared	per lb		to	25 00
Turkish	per lb	14 00	to	18 00
Jessamine	per lb		to	3 50
Juniper	per lb		to	1 20
Berries, true	per lb		to	3 50
Lavender, Garden, forte	per lb		to	1 65
fine	per lb		to	1 85
Flowers, Chiris, No. 1	per lb		to	3 75
Lavender Spike	per lb		to	1 00
Laurel, Expressed	per lb		to	90
Lemon, Donner's	per lb		to	4 50
Lemon,—G. R. & Co's	per lb		to	4 50
—Sanderson's (new)	per lb		to	4 75
Lemongrass,—Winter's	per lb		to	6 00
Mace, Expressed	per lb		to	2 50
Marjoram	per lb		to	1 75
Myrrbane	per lb		to	2 00
Neroli Bigarade	per oz		to	5 00
Chiris	per oz		to	4 75
Petit Grain	per lb		to	25 00
Olive, pure	per gal		to	1 75
Marseilles, quarts	per box		to	6 00
pints	per box		to	7 25
Orange	per lb		to	4 25
Origanum	per lb	75	to	1 40
Patchouly	per oz		to	4 25
Pennyroyal	per lb	3 75	to	4 00
Peppermint, pure	per lb	5 50	to	6 00
Rhodium	per lb		to	10 00
Rose, Kissaulick	per oz		to	10 00
Rosemary, French	per lb		to	1 75
Trieste	per lb		to	1 15
Chiris	per lb		to	2 25

Oil, Sabine, pure	per lb	to	1 70
Sassafras	per lb	to	1 10
Sesame, Salad, fine	per gallon	to	2 60
Spearmint, Hotchkiss	per lb	to	5 50
Spike	per lb	to	
Succinum, crude	per lb	to	60
r ctified	per lb	to	70
Tanzy,—"Eastman's"	per lb	to	5 00
Thyme, white, pure	per lb	to	2 75
Valerian	per lb	to	18 00
Wintergreen	per lb	to	4 75
Wintergreen, Van Deusen Bros	per lb	to	4 75
Wormwood	per lb	to	7 00
Wormseed, Western	per lb	to	2 75
Baltimore	per lb	to	3 50
Black Pepper	per lb	to	1 25
Cognac	per oz	to	3 50
Ergot	per oz	to	25
Opium	per lb	to	15 00
Orange Buds or Apples	per lb	to	18
Curacoa Ribs	per lb	to	28
Otto Rose, pure	per oz	to	10 00
commercial	per oz	to	7 00
Peppers, Zanzibar	per lb	to	33
Phosphorus	per lb	to	1 20
Amorphous	per lb	to	3 25
Piperin	per oz	to	1 50
Podophyllin	per oz	to	80
Poppy Heads	per lb	to	25
Potassa, Acetate	per lb	to	75
Bicarbonate	per lb	to	35
Carbonate	per lb	to	20
Caustic, common	per lb	to	65
white	per lb	to	95
Citrate	per lb	to	1 15
cum Calce	per lb	to	75
Hypophosphite	per lb	to	4 25
Permanganate, ordinary	per lb	to	80
Phosphate	per lb	to	2 75
Prussiate	per lb	to	44
Sulphate	per lb	to	16
Tartrate	per lb	to	1 05
Potassium	per oz	to	3 75
Bromide	per lb	to	1 65
Cyanide, fus	per lb	to	82
gran	per lb	to	1 50
Iodide	per lb	to	5 10
Sulphuret	per lb	to	35
Quinine, Citrate, with Iron	per oz	to	85
Sulphate, American	per oz	to	2 50
French	per oz	to	2 45
Quassia, rasped	per lb	to	7
Red Chalk Fingers	per lb	6½ to	7
Red Precipitate	per lb	to	1 15
Resin of Jalap, pure	per lb	to	28 00
Rochelle Salt	per lb	to	53
Roots, Aconite	per lb	to	24
Alkanet	per lb	17 to	18
Althea	per lb	to	22
Angelica	per lb	to	35
Calamus	per lb	20 to	60
Colchicum	per lb	to	20
Colombo	per lb	to	22
Culveris	per lb	to	20
Dandelion	per lb	to	30
Galangal	per lb	to	12
Gentian	per lb	to	20
Ginger, Race, African	per lb	to	20
Jamaica, Bleached	per lb	to	30
Golden Seal	per lb	to	30
Hellebore black	per lb	to	16
white, powdered	per lb	to	30
Ipecacuanhæ	per lb	to	3 15
powdered	per lb	to	3 25
Jalap	per lb	to	2 00
powdered	per lb	to	2 30
Licorice	per lb	to	18
Mandrake	per lb	to	15
Orris, Florentine	per lb	to	17
Verona	per lb	to	15
Pink	per lb	to	33
Rhatany	per lb	to	30
Rhubarb, E. I	per lb	2 50 to	4 00
Turkey	per lb	to	24 00
Sarsaparilla, Honduras	per lb	to	60
Mexican	per lb	to	28
Turbeth	per lb	to	60
Valerian, English	per lb	to	55
Dutch	per lb	to	40
German	per lb	26 to	35
Vermont	per lb	to	40
Snake, Virginia	per lb	to	44
Seneca	per lb	to	50
Rose Leaves	per lb	to	2 50
Rosemary Leaves	per lb	to	12
Rubigo Ferri	per lb	to	10
Saffron, American, new	per lb	to	2 75
Spanish, true	per lb	to	17 00
Sago, Pearl	per lb	to	12
Salicin	per oz	to	60
Sal Acetoscella	per lb	to	55
Ammoniac	per lb	to	16
Soda, Newcastle	per lb	to	5
Santonine	per oz	to	1 80
Sassafras Bark	per lb	to	10
Scammony, virg., true	per lb	to	20 00
Seeds, Anise	per lb	to	25
star	per lb	to	55
Canary, Dutch	per bush	to	5 00
Smyrna	per bush	to	5 00
Cardamom, Malabar	per lb	to	4 60
Carui	per lb	to	22
Celery	per lb	to	75
Clover	per lb	to	16
Colchicum	per lb	to	24
Coriander	per lb	to	16
Cummin	per lb	to	30
Fennel	per lb	to	20
Fœnugreek	per lb	to	12
Hemp	per bush	to	2 25
Linseed, American clean	per tierce	to	
rough	per bush	to	2 50
Bombay (gold)	per bush	to	2 50
Calcutta (gold)	per bush	to	2 55
Mustard, brown	per lb	to	16
white	per lb	to	16
Rape	per bush	to	5 25
Timothy	per bush	to	5 00
Worm	per lb	to	28
Seidlitz Mixture	per lb	to	45
Senna, Tinnevelly	per lb	to	28
Alexandria	per lb	to	50
E. I	per lb	to	25
Smalts, Blue	per lb	to	22
Snuff, Lorillard's Maccaboy	per lb	to	78
Coarse Rappee	per lb	to	1 00
Irish High Toast	per lb	to	85
Fresh Scotch	per lb	to	85
Soap, Castile, Mottled	per lb	to	16
White	per lb	to	27
floating	per lb	to	27
Low's Brown Windsor	per grs	to	15 00
Soda Acetate	per lb	to	80
Chlorate	per lb	to	2 15
Chloride, Liquor	per gal	to	45
Citrate	per lb	to	1 00
Hydrosulphate	per lb	to	1 05
Hypophosphite	per lb	to	4 10
Hyposulphite	per lb	to	10
Nitrate, pure	per lb	to	22
Phosphate	per lb	to	81
Pyrophosphate	per lb	to	1 25
Sulphite	per lb	to	32
Ash	per lb	to	4½
Sodium	per lb	to	11 00
Iodide	per lb	to	8 00
Spirit Ammonia	per lb	to	45
Aromatic	per lb	to	48
Lavender	per lb	to	48
Nitre Dulc	per lb	to	37
Rosemary	per lb	to	47
Sponges, Bahama	per lb	to	90
Bathing, Formes	per lb	to	4 00
Coarse Brown	per lb	to	60
Fine, medium	per lb	6 00 to	7 00
Surgeon's	per lb	4 00 to	7 00
Zimoca	per lb	2 00 to	3 00
Cup, Turkey	per lb	20 00 to	80 00
Trieste	per lb	4 50 to	18 00
Fine Toilet, bleached	per lb	12 00 to	15 00
Fine Trieste, small	per lb	4 00 to	4 50
Glove	per lb	1 75 to	2 00
Grass	per lb	to	25
Sheep's wool	per lb	1 60 to	1 70
Sur Choix	per lb	to	5 50
Squills	per lb	to	12
St. John's Bread	per lb	to	8
Strontia, Muriate	per lb	to	30
Nitrate	per lb	to	30
Oxalate	per lb	to	1 80
Strychnia, Acetate	per oz	to	3 75
Citrate	per oz	to	75
Nitrate	per oz	to	3 50
Pure, crystallized	per oz	to	3 25
powdered	per oz	to	2 75
Sulphate	per oz	to	4 00
Valerianate	per oz	to	5 50
Styrax Calamita	per lb	to	55
Sugar of Lead	per lb	to	40
Sugar of Milk	per lb	to	58
Sulphur Sublime	per lb	6½ to	7
Tamarinds	per lb	to	10
Tannin	per lb	2 50 to	2 60
Tapioca, East India, white	per lb	to	12½
Pearl	per lb	to	15
Tartar Emetic, powdered	per lb	to	90
crystallized	per lb	to	1 10
Tin Foil, thin	per lb	to	45
French, No. 15	per lb	to	80
Tobacco	per lb	to	40
Tonqua Beans, Para	per lb	to	65
Augustora	per lb	to	85
Uva Ursi, American	per lb	to	12
French	per lb	to	15
Vanilla Beans, Bourbon	per lb	13 00 to	16 00
Mexican	per lb	15 00 to	18 00
Venice Turpentine	per lb	to	33
Veratria	per oz	to	5 25
Vitriol, Blue	per lb	to	15
Green	per lb	1½ to	8

Vitriol, White	per lb	to	9
Wax, White,—J. I. Elkens	per lb	to	80
No. 2	per lb	to	77
Phillips'	per lb	to	90
Yellow	per lb	to	52
White Wax,—Leonhardt's	per lb	to	90
Ockmid	per lb	to	82
Sun-bleached	per lb	to	80
White Precipitate	per lb	to	1 50
White Pepper	per lb	to	58
Wine, Colchicum Seeds	per lb	to	1 40
Wood Naphtha	per lb	to	95
Wormwood Herb	per lb	to	25
Yellow Bark	per lb	to	30
Dock	per lb	to	25
Zaffre	per lb	to	1 15
Zinc, Acetate	per lb	to	1 25
Chloride	per lb	to	1 80

DYES AND DYESTUFFS.

Aniline Blue	per lb	to	8 50
Red	per lb	to	8 50
Violet	per lb	to	8 00
Annatto	per lb 1 00	to	1 75
Cochineal, Honduras	per lb	to	1 40
Mexican	per lb 1 30	to	1 40
Cudbear	per lb 28	to	45
Cutch, Pegue	per lb	to	15
Gambier	per lb	to	8
Indigo, Bengal, fine	per lb	to	3 25
good	per lb 2 50	to	2 75
middling	per lb 2 00	to	2 10
Madras, fine	per lb	to	1 70
ordinary	per lb	to	1 40
Kurpah	per lb	to	
Guatemala	per lb	to	2 00
Caraccas	per lb	to	1 65
Lac Dye, good to fine	per lb 55	to	60
Logwood, Campeachy	per lb	to	2¾
Honduras	per lb	to	2¾
Jamaica	per lb	to	2¾
Laguna	per lb	to	2½
St. Domingo	per lb	to	2½
Extract	per lb 16	to	20
" in bulk	per lb 16	to	16½
Lima Wood (gold)	per bbl	to	70 00
Madder, Dutch	per lb	to	22
French	per lb	to	23
Nutgalls, Blue, Aleppo	per lb	to	40
Orchille	per lb 30	to	35
Persian Berries	per lb 50	to	55
Safflower	per lb 60	to	65
Sapanwood	per lb	to	15
Turmeric	per lb	to	15
Ultramarine	per lb 28	to	45
Woad	per lb 15	to	16

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials	50	percentage	discount.
German Flint Bottles and vials	30	"	"
Flint Bottles and vials	25	"	"
Furniture Ware	10	"	"
Perfumer's Ware	25	"	"
Chemical Ware	net	"	"
Syringes	10	"	"
Homœopathic vials	10	"	"

NAVAL STORES.

Pitch, City	per bbl	to	4 00
Rosin, Extra Pale	per 280 lbs 8 00	to	
Pale	" 7 00	to	
No. 1	" 5 00	to	
No. 2	" 4 00	to	
Strained	" 4 00	to	
Common	"	to	3 75
Spirits, Turpentine (North Carolina)	per gal	to	55
Turpentine, Soft	per 280 lbs	to	8 00

OILS.

Linseed Oil, American	per gal	to	1 10
English	per gal	to	1 10
Palm Oil	per lb	to	16
Paraffine Lubricating Oil	per gal	to	40
Sperm, Crude	per gal	to	2 10
Sperm, Winter, unbleached	per gal	to	2 20
Lard Oil Prime, City	per gal	to	1 75
Red Oil, City distilled	per gal	to	70
Red Oil, Saponified	per gal	to	78
Whale, Crude	per gal	to	1 15
Whale, Bleached, Winter	per gal	to	1 25

PAINTS (DRY).

Asphaltum, opt	per lb	to	7
Barytes, Foreign	per ton	to	45 00
Barytes, American	per lb	to	2
Black Lead	per lb 8	to	12
Black Ivory, drop, fair	per lb 10	to	18
good	per lb 18	to	20
best	per lb 24	to	28
Blue Celestial, good	per lb	to	14
Chinese	per lb	to	1 00
Prussian, fair to best	per lb 35	to	1 00
Ultramarine fair to best	per lb 23	to	45
Chalk, Lump	per lb	to	2¼
China Clay	per lb	to	2½
Chalk	per bbl	to	4 50
Green Paris, fair to best	per lb 35	to	50
Green Chrome, fair to best	per lb 33	to	42
Lamp Black—Coach Painter's—L. Martin & Co.'s	per lb 23	to	25
Lamp Black, ordinary	per paper 8	to	12
Litharge, powdered, American & English	per lb 11	to	11½
Ochre, Yellow, French, dry	per lb 2½	to	4
Red Venetian	per lb 3½	to	5
Red Indian, fair to best	per lb 11	to	18
Red Lead, American	per lb 11	to	12
English	per lb	to	14
Rose Pink	per lb	to	20
Sienna, American	per lb 7	to	9
Italian, Brnt	per lb 18	to	22
Raw	per lb 15	to	20
Umber, Crude, Turkey	per lb 5	to	7
burnt	per lb 8	to	9
Tieman's Calif. Vermilion	per lb	to	1 00
Pure Carmine	per lb	to	14 00
Soluble Blue	per lb	to	1 25
Vermilion, English, pale	per lb	to	1 10
deep	per lb	to	1 10
American	per lb	to	35
Chinese	per lb	to	1 20
Trieste	per lb	to	1 20
White, China	per lb	to	22
Cremnitz	per lb	to	30
Lead, pure	per lb 13	to	14
good	per lb 9	to	11½
Paris	per lb 3½	to	4
Zinc, American	per lb 10	to	12½
Zinc, French	per lb 14	to	16
Whiting	per lb		3

PAINTS (IN OIL).

Black coach	per lb 28	to	30
Blue, Chinese	per lb 90	to	1 00
Prussian, fair to best	per lb 35	to	30
Brown, Van Dyke, fair to best	per lb 20	to	28
Dryer, Patent, American	per lb 12½	to	14
English	per lb 12½	to	15
Green, Chrome	per lb 18	to	27
Imperial	per lb 15	to	18
Paris	per lb 33	to	42
Verdigris	per lb 25	to	63
Putty, in bladders	per lb	to	5½
in bulk	per lb	to	5
Red Venetian, fair to best	per lb 8	to	16
Sienna, burnt, fair to best	per lb 22	to	35
White Lead, English, B. B	per lb	to	16
American, pure	per lb 13½	to	14
good	per lb 11	to	12½
fair	per lb 9	to	10
White Zinc, American	per lb 10	to	13
French	per lb 15	to	15½
Yellow Ochre	per lb 9	to	10
Chrome, fair to best	per lb 16	to	32

SPICES.

Cassia, in mats	per lb	to	70
Cloves	per lb	to	40
Ginger, Race, African	per lb	to	19
Mace	per lb	to	1 60
Nutmegs, No. 1	per lb	to	1 45
Pepper	per lb	to	38
Pimento, Jamaica	per lb	to	84

WINDOW GLASS.

American Window—1st, 2d, 3d, and 4th qualities.

6	by	8	to	8	by	10	Per fifty feet	$ 6 25 to 3 75
8	by	11	to	10	by	15	"	6 75 to 4 75
11	by	14	to	12	by	18	"	7 50 to 5 50
13	by	16	to	16	by	24	"	8 50 to 6 00
18	by	22	to	18	by	30	"	10 00 to 7 00
20	by	30	to	24	by	30	"	12 50 to 8 00
24	by	31	to	24	by	36	"	14 00 to 9 00
25	by	36	to	26	by	40	"	16 00 to 10 00
28	by	40	to	30	by	48	"	18 00 to 14 00
24	by	54	to	32	by	56	"	20 50 to 16 00
32	by	58	to	34	by	60	"	24 00 to 18 00
34	by	62	to	40	by	60	"	26 00 to 21 00

The above is subject to a discount of 30 per cent.

French Window—1st, 2d, 3d, and 4th qualities. (Single thick.)

6	by	8	to	8	by	10	Per fifty feet	$ 6 25 to 4 75
18	by	11	to	10	by	15	"	6 75 to 5 00
11	by	14	to	12	by	18	"	7 50 to 5 50
13	by	18	to	16	by	24	"	8 50 to 6 00
28	by	22	to	18	by	30	"	20 00 to 7 00
20	by	30	to	24	by	30	"	12 00 to 8 00
24	by	31	to	24	by	36	"	14 00 to 9 00
25	by	36	to	30	by	48	"	16 00 to 10 00
28	by	40	to	30	by	48 (3 qlts)	"	18 00 to 14 00
34	by	54	to	32	by	56 (3 qlts)	"	20 50 to 16 00
32	by	56	to	36	by	60 (3 qlts)	"	24 00 to 18 00
34	by	52	to	40	by	60 (3 qlts)	"	26 00 to 21 00

Subject to a discount of 30 per cent. English sells at 10 per cent discount of the above rates.

THE CHEMICAL NEWS.
Vol. V. No. 3. American Reprint.

THE FARADAY LECTURE,

DELIVERED BY

M. J. DUMAS,

Sénateur; Président de la Commission des Monnaies et Médailles; Member, and one of the Perpetual Secretaries, of the Institute; Inspecteur Général de l'Enseignement Supérieur; Président de la Société d'Encouragement pour l'Industrie Nationale; Grand Croix de la Légion d'Honneur, &c., &c.

BEFORE THE

CHEMICAL SOCIETY OF LONDON,

IN THE

THEATRE OF THE ROYAL INSTITUTION,

Thursday, June 17th, 1869.

Gentlemen,—You have desired that the memory of Faraday should be handed down to posterity; you have summoned together men of science, all to celebrate in a solemn manner, his great and beneficial labours; and, calling upon France to take the lead in this solemnity, you have chosen me to be his panegyrist, no doubt on account of the long and constant friendship with which I was honoured by Faraday.

I am the bearer of the acknowledgments of the scientific men of France, as well as my own. My country—I am proud to say it—can offer representatives of science much more worthy of your approbation; but I know no one, at least, who feels more intimately the sentiments of profound gratitude for the noble welcome which England has accorded for so long a time, nor do I know one who bears so sincere a veneration for Faraday.

The name of your illustrious fellow-countryman is not one which any single nation can claim as its exclusive property; his labours and discoveries are as widely recognised in France, in Germany, and in America as in England. Faraday belongs to the whole world. There is not a spot on this earth to which civilisation has penetrated, that does not claim the right of partaking of the respect and gratitude you entertain for him.

Faraday was identified with the scientific movement of the first half of this century; he was one of its principal leaders, and drew in his train a whole host of thinkers, engineers, men of enterprise, and capitalists. Ever contemplating the chaste beauties of nature, and searching into her most hidden recesses, this disinterested philosopher, this deep thinker, scattered broadcast on his path the seeds of the most extraordinary and unheard-of results—such are the electric currents of Faraday that bear our messages, furrowing Europe and traversing the Atlantic—such are those lights, rivalling the sun in brilliancy, which shine forth from our principal lighthouses; and it is even to the gases which he liquefied that hot countries owe the luxury of ice.

In the pursuit of truth alone, he was able to satisfy, as if by accident, the boldest demand of a refined civilisation; and, devoted to the ideal, he sowed the seed of riches, not for himself, for he despised them, but for the profit of trade, which has gathered the fruit.

Faraday is the type of the most fortunate and most accomplished of the learned men of our age. His hand, in the execution of his conceptions, kept pace with his mind in designing them; he never wanted boldness when he undertook an experiment, never lacked resources to ensure success, and was full of discretion in interpreting results. His hardihood, which never halted when once he had undertaken a task, and his wariness, which felt its way carefully in adopting a received conclusion, will ever serve as models for the experimentalist.

The study of nature entirely puts aside conjecture, and places a guard on vague hypotheses; it begins with facts, ascends to laws, and raises itself, as far as the limits of man's intellect will permit, to the knowledge of causes, by the triple means of observation, experiment, and logical deduction. A long familiarity with the exact detail of phenomena can alone give to a man, as to Faraday, the right of being bold; he is, like Faraday, restrained when he has a thorough appreciation of the limits of man's knowledge. It is two centuries ago since Europe received this system of philosophy from Galileo and Newton, characterised at that epoch by the establishment of the Academy of Naturæ Curiosorum, in Germany, which represented the art of observation; in Italy, by the Academia del Cimento, the school of experimental science; and in England and France, by the Royal Society of London and by the Académie des Sciences de Paris, which adopted mathematical science as one of the means most conducive to the knowledge of truth in the domain which is accessible to us.

What an awakening for Europe! After two thousand years, she found herself in the same position to which she was raised by the profound intellect of India, and the acute genius of Greece, by Aristotle, Plato, Archimedes, and their emulators, from which, during those long ages, she was permitted to fall, whilst the work of the assimilation of races was being carried on under the political influence of Rome.

What would have been the result if the learning of the Greeks, continuing its development from the third century before Christ to our own days, had pursued its triumphant march without hindrance? We do not know; no more than we can forecast the material resources of the human race after twenty centuries, nor to what heights the science of nature will have risen, should no social revolution create a breach in its tradition or retard its progress.

Greek art presents inimitable models; Greek philosophy has forestalled the modern schools in all their fearless opinions; and Greek science, not less prolific, paved the way which Europe has followed after long hesitation.

It is not difficult to connect Leucippus, a contemporary of Alexander the Great, who first clearly enunciated the philosophical doctrine of atoms, and the illustrious physicist of Manchester, Dalton, who, at the commencement of this century, founded, upon experiment, the atomic theory of modern chemists. Between these two points, so far removed, there is no intermediate link. Dalton is the son of Leucippus. Thus Cuvier, too, whose inventive genius was greater than that of Aristotle, was the sole inheritor of his spirit of order, his love of method, and his strength of judgment. In the same manner, we may ascend directly from Galileo and Newton, to Archimedes and Plato; the ideas of Faraday, too, on matter, atoms, force, and motion, were those of a Greek philosopher. The Romans did not receive this inheritance from the Greeks; given more to practical pursuits, they did not recognise the fact that these owed their progress to pure theory.

Truth is so beautiful that it deserves every effort a man can bestow to gain it; it is so fruitful that it carries along with it its own recompense. In placing be-

[English Edition, Vol. XX., No. 501, pages 1, 2.]

fore our mind the end, without occupying ourselves with particulars, we find the ordinary details of well-being and riches fall into their proper places.

Has not the atomic theory of Dalton, in assigning limits to phenomena, renewed the whole art of chemistry? Has Lavoisier's theory of combustion ever ceased to direct agriculture, the useful arts, health, and therapeutics? Did not these two philosophers contemplate abstract truth in all its splendour, and after receiving it from above, was it not sufficient for them to cast their eyes upon the earth, to reflect its light, and to spread far and wide its fruitful and exhaustless seed?

Let us, then, continue faithful in the cultivation of science for itself, and trust, without anxiety, that it will bear practical fruit for itself. Our remembrance of the life of Faraday teaches us that moral truth, when implanted in a man's heart, develops, at the proper time, each virtue that life exacts. His labours show us that the same holds good with scientific truth. At the proper time, it produces, as well as many spontaneous fruits, each of those discoveries which civilisation demands.

To a nation ambitious of becoming famous in history, it should be said: "Despise conquest, abandon the pursuit of riches, and seek Truth, for by that your memory will be perpetuated." In like manner it may be said to a people who desire war or fear it, who wish to remain agriculturists or seek the advantages of commerce: "Search for Truth; it will create your means of defence or attack, maintain the fertility of your plains, and furnish your manufactories with resources against competition." The princes of bygone times considered themselves enriched and assured of prolonged youth, if they could obtain an alchemist capable of making gold, and possessed of a panacea against mortality. The nations of the present day, better advised, seek the aid of chemistry, and place in its counsels their hopes of well-being and honest gain: they know the value of artificial soda, chlorine, gas illumination, stearine candles and aniline dyes, and are grateful for the labour and care which these discoveries have cost.

Everything must give way to the laws of nature, and he only who has mastered those laws can control her processes. But the mastery cannot be obtained without a struggle; the fable of Proteus is a true picture of the combat between man, eager for knowledge, and the stubborn guardian, charged with the preservation of the secrets of destiny. Proteus changed himself into a thousand shapes before speaking, and yielded only to the hero who, far from being moved by his transformations, bound him with bands of increasing pressure. Such is nature herself, her answers are always true, but like the ancient shepherd of Neptune's flocks, before allowing Truth to shine forth, she arrays herself in the garments of error, or hides herself behind the phantoms of illusion; and will only assume her proper shape under the determined pressure of a resolute disciple of Science. This indomitable courage was possessed by Faraday in the highest degree.

The struggle for mastery is often prolonged. The whole life of a man does not suffice; the meeting of many philosophers animated by the same idea, or even the labours of different generations devoted to one pursuit, are required for the attainment of success; hence free associations for the cultivation of physical science, and laboratories, where young men full of faith and ardour, working under one head, unite in the execution of such plans as he may invent or approve. Private study, which was perhaps best adapted to Faraday's temperament, but which prevented him from establishing a school, has been succeeded by the labours in common of learned societies, and work carried on simultaneously by pupils in the same laboratory. Enlightened countries at last comprehend that all scientific research is a battle to be won, and that every victory increases national power. Intelligent nations no longer deny to scientific men, worthy the name of captain, either arms for the contest, soldiers devoted to their cause, or subsidies for their maintenance. Science is no longer an unrecognised power of which, nevertheless, much is expected; to-day, every government which does nothing for it must expect to be vanquished by rivals, and to receive the censure of posterity for its want of forethought.

When Christopher Columbus set out for the conquest of the New World, did he not require ships, sailors, provisions, and ammunition? How then can the new world of science be conquered without assistance?

For texile manufactures there must be raw material, machinery, workpeople. The best workman in England, left to his own resources, would be unable to make an inch of cloth. It is the same with scientific discoveries; to weave the weft, there must be raw material, laboratories, apparatus, and reagents. The more eminent a scientific man may be, so much the more is he powerless to resolve unaided all the questions which arise in his mind, and to develope all the views suggested to him by the new aspects of nature, which his penetration has reached.

How many *chefs-d'œuvre* might have been lost to us if Raphäel, protected by an illustrious Pope, had not been the centre of a brilliant and devoted school, capable of sparing him the actual labour required to develope his ideas! What discoveries will be made when scientific masters of all countries, raised to their true position, are no longer limited in their resources, confined as to their means of execution, and obliged to do everything with their own hands!

The high position held by Faraday allows of such a comparison, and we may regret the loss of the discoveries which might have been added to those with which he has benefited the world, if, like Raphäel, he would, or could, have founded a school. Learned societies formerly chose as a subject for their solemnities, an encomium on those monarchs or ministers whose protection they enjoyed. This meeting presents a spectacle more in conformity with the dignity of science: Faraday indeed raised himself above his fellows like a prince, but as a prince of thought; he exercised his power like a minister, but as a prime minister of the power and forces of nature.

His life is likewise an epoch of intellectual progress; and our immediate posterity will speak of such and such discoveries as having been made in the time of Faraday; sure of being as well understood as if referring to events in history, as being of the time of Elizabeth or Charlemagne.

But the life of Faraday is known to you, and you are familiar with his labours. I cannot fail of rendering that homage to his memory which he would have desired himself if, together with you, I review the progress of those sciences to which he was devoted.

Since the commencement of this century, three nations, animated with a noble spirit of rivalry—England, Germany, and France—have been contending for the first place in the study of physical science. Warranted, by turns, in claiming superiority, no one of them has dreamed, for one instant, of abdicating its claims.

From this generous strife have sprung innumerable labours, the boast of our age, which will imprint a character upon it in history.

I do not wish to review, nor even to point out, the advantages that these nations have received from the liberal hand of science, but to bring before our minds the acquisitions to our knowledge of matter and force, to point out those fundamental ideas which have been brought to light, and to call to mind the part we must attribute to Faraday in this wonderful movement. I propose, then, to examine what we have learnt with regard to—1st, the nature of concrete matter; 2nd, the forces which it obeys; 3rd, the nature of truly-organised matter; 4th, the force which animates it.

The Greeks considered all matter divisible into four irresolvable elements, viz., earth, water, air, and fire, which are concrete representations of the abstract ideas solidity, liquidity, gaseous state, heat. So far they were guided by their senses; but they were of opinion that, finally, matter was made up of inaccessible atoms, and that variety, in the number or the arrangement of the latter, accounted for all the varieties in natural substances.

At the present day, with Lavoisier, we give the name of elements to all substances which we cannot break up or resolve; but hold, with Dalton, that these elements are themselves made up of atoms which unite in different proportions, and with varying arrangements, to form different compounds.

To sum up, matter can be reduced to substances which no longer admit of reduction, and these substances are the elements of modern chemists; matter has only three forms, the solid, the liquid, and the gaseous, which stand for the elementary substances of the Greeks; matter is agitated by different motions, which may be all represented by one alone—heat—as all the rest may be transformed into it.

Lavoisier demonstrates that these are substances which cannot be resolved into simpler parts, and these he calls elements; Dalton asserts that the latter are substances combined in unvarying proportions, and he gives the name of atoms to these proportions reduced to their simplest form. Are not the elements of Lavoisier subject to decomposition in their turn? Cannot the methods recognised by Dalton be brought under a more general statement? May not chemistry be in the same state as astronomy with Kepler's laws, and is it not waiting for its Newton?

We are inclined to believe in the absolute simplicity of Lavoisier's elements when we consider,—1st, that, since the commencement of civilisation, no power at man's disposal, no natural action observed by him, has been able to break them up; 2ndly, that when converted into gas, their atoms occupy the same space as before; 3rdly, that in the solid state their atoms have the same volume when we deal with analogous elements; 4thly, that in the last case their forms are identical, so that they can replace and displace one another mutually in their compounds, without any great change of properties; 5thly, that the heat required by atoms for a change of temperature, is the same, no matter how they differ in weight; lastly, that in order to separate them when united, any atom whatever requires the same amount of electricity as any other. But, with the exception of inalterability, all these properties, not excepting the last, one of Faraday's best discoveries, are found in all compounds of the same order; we have, then, only a right to say that Lavoisier's elements are substances of the same order, and if we may say that they *cannot* be resolved, it is only because they *have not* been resolved.

We are inclined to think Lavoisier's elements further reducible from considering—1st, their number, which has risen in less than a century from thirty-one to sixty-five, and which grows rapidly; 2nd, their natural classification by families, the different numbers of which approach gradually, like terms in a continuous series 3rd, their indubitable analogy with organic radicals, which are compounds.

In this way, Faraday's idea, that the atoms composing simple substances are collections of centres of force diversely arranged, may be defended. Chemical atoms would be the starting-point of the analysis; mechanical atoms its last stage.

However, the question has entered upon another phase since the most recent discoveries. Natural philosophy has enabled us to determine the elements which are in incandescent matter, by means of the character of the spectrum formed by the latter.

The fact that Lavoisier's elements have resisted for the millions of years that they have been on the earth all the efforts of nature and of man to reduce them, is a characteristic of simplicity. Now we can say that these elements have resisted every effort at destruction in space as well as in time. We find in the sun, in the fixed stars, in the nebulæ, and in comets themselves—that is, within our system and without our system—the elements which we have known on earth; we find the same metals, hydrogen, nitrogen, &c.

When we are taught by the beautiful discoveries of Messrs. Janssen, Lockyer, and Frankland, that the protuberances on the sun are only incandescent hydrogen, we ask, How shall it be possible to reduce this element if the temperature of the sun do not suffice for its reduction?

As far as man can go back in time, as far as man can reach by observation in space, the concrete elements of matter present the same character as Lavoisier's elements.

In their abstract forms, reduced to mere centres of force, these elements, if such be the name for matter in its final state, belong to an immense tract, and soar up into a region of thought, inaccessible to man both in space and in time.

The examination into the modifications which have taken place in our ideas on the subject of force authorises us in going back to an age long before the commencement of this, for from thence the changes in our ideas take their date. Then matter used to be placed under the dominion of universal attraction, of motion, of light, of heat, of electricity, of magnetism, of chemical affinity, of cohesion, of the force of solution, of capillary attraction, and, later, of endosmose, &c.

It was no longer the philosophy but the mythology of Greece that served as a model. Natural forces occupied the position with regard to modern science that the divinities of old did with respect to Olympus, and people came to attribute to the former, as they had done to the latter, distinct and inalienable personalities.

At the present day, we know that light and heat have many properties in common, that electricity can be changed into magnetism, and *vice versa*, and that mechanical action can produce heat, magnetism, electricity, light. This correlation of physical force, as Mr. Grove call's it, the data for which were given by Ampère, Melloni, and before them by Sady Carnot, and confirmed by the crucial experiments of Faraday, remove all doubt. These forces are different modes of

motion, and all these modes of motion can be transformed one into the other.

The man with vulgar cravings sought for the transmutation of matter, and failed to find it; he had little care for the transmutation of forces, the deep meaning of which none but the philosopher understood, and as a reward for the disinterestedness of the latter, the truth was revealed to him.

One of my most eminent fellow-labourers, one of my countrymen who has many friends here, and whom you have heard in this theatre, M. Henry Ste. Claire Deville, has just proved the existence of a close alliance between affinity and mere physical attraction, by the discovery of dissociation, which will influence the progress of chemistry materially.

We cannot deny that there exists close relationship between affinity on the one hand, and mechanical force on the other, when we see the decomposition of a body, such as marble when submitted to the action of a steady heat, come to a stand in the same way and from the same causes as the vaporisation of a liquid *in vacuo*.

This is the first step that has been taken to bring chemical phenomena under the laws of mechanics, and to justify Newton's view that chemical attraction was a particular case of universal attraction.

Has not Mr. Graham, in turn, reduced to causes purely mechanical the manifold effects of diffusion, of endosmose, of capillarity? Has not this illustrious philosopher been led by his latest researches to manifest, not only the metallic character of hydrogen by a memorable discovery, but to seize the very moment at which the phenomenon of the mechanical condensation of a gas by a porous body changes into a truly chemical combination?

There remains, then, universal attraction which, acting on heavy bodies, guides the motion of the stars as well as that of atoms; a motion which produces heat, light, electricity, and magnetism.

The study of matter leads us to the knowledge of an ever-increasing number of elements, and of simpler and simpler forces. Matter which was always believed to be conceptible and susceptible of transmutation, has resisted the efforts of man; whereas physical forces which were considered to be beyond his reach are shown to be ephemeral, and change one into the other readily.

But what relation connects gravitation with the other forces in nature? We know not; and Faraday, who has meditated on this point all his life, and who has thrown such vivid light on all its surroundings, has not made one step towards the solution of the problem.

What is the cause of gravity itself? We now know no more than was known two hundred years ago, in Newton's time.

What is meant by organic matter? If one were influenced by the views of the old chemistry, there would be no difficulty in replying. All organic matter originated in plants or animals; it was destructible by heat; it contained, generally, carbon and hydrogen, often oxygen, sometimes azote. Thus it was a compound of which carbon formed the fundamental element, destruction by fire the chief characteristic, but which, above all, derived its organic character from the circumstances of its origin.

At that time, no one thought of confounding organic chemistry and mineral chemistry. At the present day, this fusion exists in all purely chemical substances; only the terms of this assimilation are not understood. We are dazzled by a quibble. My age, and the share I have had in this movement in science, compel me to explain clearly my opinion, and to endeavour to put an end to the misconception.

The first studies we pursue on the chemical phenomena of life teach us that plants create, and animals destroy, organic matter. The sun appears as the agent by whose means this matter is produced, and combustion by the air that animals breathe, as the process that destroys them, in order to restore their elements to the state of "brut" matter.

The chemical forces placed at the disposal of life, descending on the earth under the forces of light, disappear by radiating off into space under the form of heat. An equilibrium obtains between the vegetable and animal kingdoms for receipts and disbursements, represented by these two forms of motion—light and heat; and the amount of animal life which may be developed on the globe is measured by the amount of food that vegetable life has prepared for it. The dark rays of heat appear to carry off from the earth that which radiant and brilliant light has spread over it.

On looking more closely into it, however, it was found that matter of organic origin was divided into two groups; one so rich in species that it surpasses all that has ever been imagined of the very numerous species of plants or animals described by naturalists; the other containing but a very few distinct species.

The first group constitutes the true organic species of chemists; that is to say, those which they have analysed, of which they have recognised the constitution, which they make by means borrowed from their own sciences, and of which they can, consequently, define the nature by analyses and syntheses.

Let us first attend to these matters. At what moment can they be characterised as organic?

Their origin does not suffice. In fact, carbon, hydrogen, oxygen, azote, can be withdrawn from plants or animals, and no one would find anything but mineral elements.

Oxide of carbon, carburetted hydrogen, cyanogen, water, and ammonia may meet in the produce of the constituents of plants or animals without any one thinking of making organic substances from these binary compounds. But old chemists gave this name to alcohol, to vinegar, to the essence of bitter almonds, to urea, for example. Now, if there is any certain principle in science, it is this. Alcohol, vinegar, essence of bitter almonds, urea, although proceeding from plants or animals, have never lived, and will never live. They are subordinate products of life; they are not necessary instruments of life.

With regard to them, chemistry need no longer hesitate. This matter is formed in the manner of mineral matter. It shows all the conditions of its composition, its structure, and its properties. One circumstance only distinguishes it, and that, even, is not absolute. Generally, mineral matter is formed of simple elements, directly united. However, we perceive sometimes that certain composite groups may act like elements, may replace them or be replaced by them in combinations, without the latter changing their general character.

That which is the exception in mineral chemistry becomes the rule in organic chemistry. Lavoisier had the presentiment of this when he wrote—"Organic chemistry is the chemistry of compound radicals."

At this day, there is no longer any doubt. Cyano-

gen, cacodyle, the metallic radicals of Dr. Frankland, are well-known substances, offering all the chemical qualities of simple bodies, and nevertheless compound.

The substitutions admit of displacing and replacing one element by another, or even, at pleasure, by a compound radical in all the organic matter of chemists without changing its type. The converse is true: there is no impediment to replacing a compound radical by an element in a combination; and this change does not alter the type of it more.

Thus, the organic materials of which we speak are similar in all their conditions or qualities to mineral materials; 1st, they contain certain compounds which play the part of elements; 2nd, they assimilate with the oxides, sulphides, chlorides; with acids, bases and mineral salts in all their properties; 3rd, their radicals can replace the mineral elements, and be replaced by them; 4th, they can replace each other reciprocally.

Like "brut" bodies, these materials are susceptible of crystallisation, of volatilisation, without becoming decomposed; they form definite combinations, are incapable of life, and never have lived.

They thus resemble mineral matter in every respect, and where they differ from it is only that they have the general principles of compound radicals, whilst the mineral species have generally the principles of elements.

Analogies are even apparent in some numerical relations known to the elements of mineral chemistry, and to the radicals of organic chemistry. These relations are manifest in the two cases, for all elements susceptible of being arranged in series or natural families.

Thus, lithium, sodium, potassium, whose respective atomic weights are 7, 23, and 39, form a series of which the difference is 16. Magnesium, calcium, iron, whose respective atomic weights are 12, 20, 28, form a series whose difference is 8.

Thus all organic radicals offer the same condition. Methylium, ethylium, propylium, butylium, &c., give a series whose difference is 14, their respective atomic weights being 15, 29, 43, 57.

It seems natural to conclude from all this evidence, not that substances thus endowed and composed are organic because they are derived from organised beings, but rather that the elements of mineral chemistry may be complex.

In any case, the assimilation of the two chemistries becomes more and more near.

This picture would be incomplete if we did not add a few more features.

The radicals of mineral chemistry formerly numbered 30, and the combinations known in nature raised the number to some hundreds; at this day we count 65 elements, and some thousands of compounds or natural mineral species.

The chemist of the last century might study them one by one, and become acquainted with them all. Such is not the mission of the chemist of the present day; the species being realised, he tries to study them in groups; the potential species he tries to create. In nature, every element produces, on an average, eight or ten species. In the laboratory, every element may form thousands of the same order as the known mineral species.

The contrast is still more striking in organic nature. The animals and plants which cover the surface of the earth are counted by hundreds of thousands, and yet their tissues and their juices, submitted to chemical analysis, resolve themselves into no more than a few hundreds of distinct chemical species.

But the power of combination is such, among the special elements which form them, that it is by thousands that they have arisen; and if we calculate the number of combinations of this kind which may be realised, it seems as easy to count the grains of sand on one of the great shores of the sea as to say to what number of figures may be raised the organic species which the chemist has to produce.

Thus mineral or organic species, counted formerly by hundreds, are now counted by thousands for the first and by millions for the second.

Whence comes this fecundity for the formation of the so-called organic substances? Many circumstances contribute to it; but the first results from the almost incalculable number of the compound radicals which it can realise. Each of them being able to give birth to a prodigious number of combinations, organic chemistry counts a very great number of heads of tribes, and each tribe an infinite number of species. The latter, already multiplied in fact for simple radicals, are much more so by the consequences of the fertile discovery of Mr. Williamson, which has taught us to unite two different radicals to each other, to bring them into a single system, and to produce with the latter as numerous compounds as were obtained from each of the isolated radicals. In consequence of the first and fundamental discovery of Mr. Graham, on the triple functions of phosphoric acid, which has been extended to the domain of organic chemistry,—for acids by M. Liebig,—for bases by M. Berthelot,—for alcohols by M. Wurtz, the result of this harmony of work, of which the immensity alarms the imagination, is that the atomic compounds with which we were chiefly engaged forty years ago, have not only been multiplied, but that they have been repeated by counterproofs. One might say, without forcing a metaphor, that we had visited and described all the rooms of the ground floor of the building; that Messrs. Graham and Liebig have revealed to us the existence of a first and second story, which repeated all their arrangements, and that Messrs. Berthelot and Wurtz have shown us that it was the same case in the basement and in the cellars. Thus five times more chambers or species have been produced at pleasure.

But, from all the sources of multiplication of substances with which organic chemistry is concerned, the most fertile is that of substitution; in fact, the discovery of the compound ammonias by M. Wurtz, and the labours of M. Hofmann which resulted from them, have produced a multitude of combinations, in which the atoms of hydrogen contained in ammonia are replaced by compound atoms performing the function of elements—that is to say, by organic radicals. If we apply the calculation to this special case, we even see that, with the known radicals employed to replace entirely, or in part, the hydrogen, or to replace each other mutually, we should henceforth be able to produce compounds derived from ammonia by hundreds of thousands or by millions.

How if we were to apply the same calculation, and the same provision to all the types?

There is yet more. The chemist is not now, as formerly, obliged to derive all the substances that he produces by these means from those yielded by animals and vegetables; he creates them at will; he no longer needs, for his starting-point, the action of solar light on plants. When he wishes to produce organic substances, he obtains his force by employing heat, formerly regarded as the true means of destroying them.

Not that he has succeeded in directly uniting carbon, hydrogen, oxygen, and nitrogen, so as to form organic substances; but, by the aid of heat alone, he first combines them two and two, and he thus forms carburetted hydrogen, carbonic oxide, cyanogen, water, and ammonia. Afterwards, by subjecting these first compounds to the action of suitable substances, and by the necessary artifices, he succeeds in regenerating, little by little, all the definite compounds of organic chemistry.

There is not a chemist who has not performed syntheses of this character; but the most striking is that of urea, by M. Wöhler; and the first, which have been grouped in a systematic manner are those which have been performed in Germany, by M. Kolbe; and especially those performed in France, by M. Berthelot, who has worked at them with great success, being the first to reproduce formic acid, and to combine directly carbon and hydrogen.

The function of the chemist changes, and becomes elevated. In presence of the numerous substances that his power evokes from the regions of the unknown, he owes his first attention to order, method, classification, and to nomenclature. But, once this first duty is fulfilled, he contemplates this innumerable host of forms, raised by his conceptions, or realised by his hands; and he applies to mathematics for a definition of the harmonics of numbers therein revealed; to mechanics, for a statement of the laws which their structures obey, or those which determine the stability of the material systems which they represent.

The Bible tells us that when God had formed, from dust, all the beasts of the earth, and all the fowls of the air, he made them pass before Adam, and that the name given to each by Adam is its true name.

In presence of this new creation, not of animated beings — whose appearance on earth depends on a power superior to his—but of harmonious forms which chemistry reproduces at will, always identical with each other, and always distinct from all others, man might sometimes forget that he has no longer merely to give names to the works of God, in order to remember that he has to name his own works.

If the discoveries which we have witnessed during the last half century do not justify pride, they at least excuse it. But, to bring back man to our appreciation of truth, it suffices to tell him that—if he has become more expert in the art of observing, if he employs with more certainty the art of experimenting, if the logic proper to the sciences leads him more surely to the discovery of the laws of nature—he has not as yet advanced one step towards the knowledge of causes.

Let us consider, in particular, what he knows on the subject of the materials which his life sets in motion in its development, and the contrast will be striking.

If I question the physiologist, on the subject of these millions, or milliards, of compounds, misnamed organic, of which the chemist transforms, reproduces, or creates at pleasure the species, he will reply to the three following questions:—Are these compounds living?—No! Have they lived?—No! Are they capable of living?—No!

If I ask the chemist himself if these compounds belong to mineral chemistry—to the chemistry of raw (brut) substances—he will reply, Yes!

Organised matter, not capable of being crystallised, but destructible by heat, the only matter which lives, or has ever lived—this matter, a subordinate agent of the vegetating power in plants, of the motion and sensation of animals, cannot be produced by chemistry; heat does not give birth to it; light continues to engender it under the influence of living bodies.

Let us not be disturbed by a quibble. The ancients admitted that nature alone produces organic matter, and that the art of the chemist is limited to transforming it. To-day we might, perhaps, even pretend that chemistry is powerful enough to replace, in all respects, the forces of life, and to imitate its processes; let us keep to the truth.

The ancients were mistaken when they confounded, under the name of *organic matter*, sugar and alcohol, which have never lived with the living tissue of plants or the flesh of animals. Sugar and alcohol have no more share of life than bone-earth, or salts contained in the various liquids. These remnants, or rubbish of life, placed amidst organic matter, are true mineral species, which must be brought back to, and retained amongst, "brut" bodies. Chemistry may produce them in the same sense that she manufactures sulphuric acid or soda, without, for all that, having penetrated into the sanctuary of life.

This subject remains what it was — inaccessible, closed. Life is still the continuation of life; its origin is hidden from us as well as its end. We have never witnessed the beginning of life: we have never seen how it terminates.

The existing chemistry is, therefore, all-powerful in the circle of mineral nature, even when its processes are carried on in the heart of the tissues of plants or of animals, and at their expense; and she has advanced no further than the chemistry of the ancients, in the knowledge of life and in the exact study of living matter; like them, she is ignorant of their mode of generation.

Where, then, is true organised matter, or matter susceptible of organisation? What is its chemical constitution? What is its mode of production? What is its manner of growth?

Instead of myriads of species, one would feel disposed to recognise but eight or ten at most, if one may be allowed to consider elementary types of organisation as chemical species. Be this as it may, in the origin of beings which have life we see cells appear, and in the heart of their types we find cells for organic elements, and, still beyond these, germs of cells.

In these cells, or in the spaces between them, we observe inert products, aliments, excretion, substances stored up. It is the cell, it is the germs which proceed from life, which live, which engender life, and then die. The substances which are contained in, or which surround these organs, are subordinate accidents, products rejected by organisation, or destined to its use, but distinct from life.

Every organised being is born of a germ; every plant from a seed; every animal from an egg. The physiologist has never seen the birth of a cell, excepting by the intervention or as the produce of a mother cell.

The chemist has never manufactured anything which, near or distant, was susceptible even of the appearance of life. Everything he has made in his laboratory belongs to "brut" matter; as soon as he approaches life and organisation, he is disarmed.

Thus, for a century past, the empirical elements of matter have been recognised and separated; their combinations have been multiplied to infinity; physical forces have been brought back to a common origin—motion—and one has been at pleasure changed into the other; and yet—

Is the intimate nature of matter known to us? No! Do we know the nature of the force which regulates the movement of the heavenly bodies and that of atoms? No! Do we know the nature of the principle of life? No!

Of what use, then, is science? What is the difference between the philosopher and the ignorant man?

In such questions the ignorant would fain believe they know everything; the philosopher is aware that he knows nothing. The ignorant do not hesitate to deny everything; the philosopher has the right and the courage to believe everything. He can point with his finger to the abyss which separates him from these great mysteries,—universal attraction which controls "brut" matter, life which is the source of organisation and of thought. He is conscious that knowledge of this kind is yet remote from him, that it advances far beyond him and above him.

No, life neither begins nor ends on the earth; and if we were not convinced that Faraday does not rest wholly under a cold stone, if we did not believe that his intelligence is present here among us and sympathises with us, and that his pure spirit contemplates us, we should not have assembled on this spot, you to honour his memory, I to pay him once more a sincere tribute of affection, of admiration, and respect!

ON JARGONIUM;

A NEW ELEMENTARY SUBSTANCE ASSOCIATED WITH ZIRCONIUM.*

BY H. C. SORBY, F.R.S., ETC.

At the *soirée* of the President of the Royal Society, on March 6th, I exhibited various spectra, differing so much from those characteristic of any known substance that I considered myself warranted in concluding that they were evidence of a new element. Since this may be studied to the greatest advantage in the jargons from Ceylon, it appeared to me that, as the name *zirconium* has been adopted for the principal constituent of zircons, so that of *jargonium* would be very suitable for this constituent of jargons.

At the above-named *soirée* I gave away a printed account of the objects I exhibited; and in this I said that jargonia "is distinguished from zirconia and all other known substances by the following very remarkable properties. The natural silicate is almost, if not quite, colourless, and yet it gives a spectrum which shows above a dozen narrow black lines, much more distinct than even those characteristic of salts of didymium. When melted with borax it gives a glassy bead, clear and colourless, both hot and cold, and no traces of absorption-bands can be seen in the spectrum; but, if the bead be saturated at a high temperature, and flamed, so that it may be filled with crystals of borate of jargonia, the spectrum shows four distinct absorption bands, unlike those due to any other known substance."†

I have since applied myself almost exclusively to the study of this substance, hoping to have been able to communicate to the Royal Society a full account of the subject this session; but so much still remains to be done that it is now impossible to do anything more than give a brief outline of the more important facts. The delay has not been because there is any difficulty in proving it to be a new substance, but because its properties are so unique, and have so much interest in connection with physics, that it appeared desirable to carefully examine all other known elements, in order to ascertain whether any of them exhibit analogous phenomena. That jargonium is quite distinct from zirconium is not only proved by the spectra, but also by other facts. Both myself and Mr. David Forbes have succeeded by entirely different processes in separating from jargons, zirconia apparently quite free from jargonia, and jargonia nearly, if not quite, free from zirconia; and, even if the separation be not perfect, it is, at all events, more than sufficient to prove that they are quite distinct. They are certainly very closely related, and are deposited from borax blowpipe beads in microscopical crystals of the same general form,* quite unlike those characteristic of other known earths; but beyond this the difference is as great as that between any other two allied elements. Judging from an analysis kindly made at my request by Mr. David Forbes, and from a comparison of the spectra, the amount of jargonia in jargons varies up to about 10 per cent. The entire or comparative absence of jargonia from the zircons of Miask, Fredericksvärn, and various other localities, appears to explain some of the facts which led Svanberg† to conclude that zircons contain more than one earth. He was so far correct, but failed to establish the existence of any substance with special chemical or physical properties; and if, as is probable, the Norwegian zircons, which, according to his views, contain such a notable quantity of this supposed new earth, as to have led him to give it the name *noria*, were from Fredericksvärn, and if the Siberian were from Miask, his norium cannot be looked upon as equivalent to my jargonium, which is almost or quite absent from those zircons.

The most remarkable peculiarity of jargonium is that its compounds may exist in three different crystalline states, giving spectra which differ from one another as much as those due to any three elements which give the most striking and characteristic spectra. Several substances can be obtained in two different physical states, giving different spectra, but usually only one of them is crystalline. The other is the vitreous or calloid condition. Crystalline minerals coloured by oxide of chromium do indeed show spectra of two different types; but, as far as I have yet seen, they never occur in the same mineral. In the case of jargonium, however, there are no less than *three* types of spectra, which are all met with in different crystalline modifications of the *self-same* compound.

The most characteristic test for jargonia is the spectrum of the borax blowpipe beads seen with a spectrum microscope, which enables us to detect it in zircons apparently containing less than 1 per cent. As much of the earth or natural silicate as will completely dissolve should be melted in a circular loop of platinum wire about ¼ inch wide, with a mixture of borax and boric acid, and a strong heat kept up till crystals begin to be deposited, owing to the loss of the solvent by volatilisation. On removing the bead from the flame it remains clear and shows a few acicular crystals, but gives no absorption bands. On reheating to a temperature just below dull redness, the bead turns white, and so

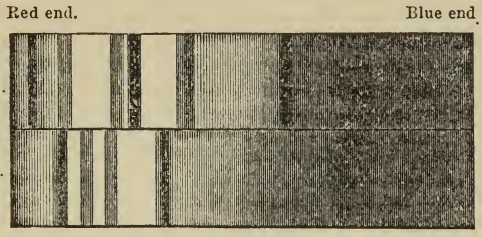
* Communicated by the author, having previously been sent to the Royal Society.

† For the further history of this subject, see Prof. Church's papers—*Intellectual Observer*, 1866, vol. ix., p. 291; Chemical News, March 12th and 19th, 1869, vol. xix., pp. 121 and 142 (*Am. Repr., May*, 1869, *pages* 231, 259); *Athenæum*, March 27th; and also my own—Chemical News, vol. xix., p. 122 (*Am. Repr., May*, 1869, *page* 231); and *Athenæum*, April 3rd.

* See *Monthly Microscopical Journal*, June, 1869.

† *Pogg. Ann.*, 1845, vol. lxv., p. 317.

very opaque that no ordinary light will pass through it. When, however, a small and very bright image of the sun is formed in the centre by means of an almost hemispherical lens of ½ inch diameter, and a cap is placed over the object glass, with a round hole of less diameter than the bead in the focus, so as to prevent the passage of extraneous light, the bead is seen to be illuminated by transmitted light of about the same brilliancy as that of a bright cloud, so that it gives an excellent spectrum without being at all dazzling.



In the case of beads containing jargonia, the character of the spectrum differs completely according to the temperature at which the included crystals are deposited. As already mentioned, the clear glassy bead gives no absorption bands; and when the crystals of the borate are deposited at as low a temperature as possible, much below dull redness, and only just sufficiently high to soften the borax, there may be scarcely any trace of bands; but if the clear bead be quickly raised to a temperature just below that of very dull redness, it suddenly becomes very opaque, and shows a spectrum with a number of remarkably distinct absorption bands (Fig. 1). The most distinct and characteristic is that in the green, then one in the red and one in the blue, and there are three others fainter, one in the orange and two in the green. On raising the temperature to bright redness, all these vanish and four others appear, none of which coincide with any previously visible (Fig. 2). Three are situated in the red and orange and one in the green, so as to give rise to a spectrum of an entirely different character.* In this state the bead is of a pale straw colour, and not almost white as before. In the case of nearly pure jargonia the beads should not be above 1-25th of an inch thick, or else they would be too opaque. Pure zirconia gives no bands whatever in any state, and the beads are white, and sufficiently transparent when two or three times as thick as just named. It might be thought that these three different spectra were due to different compounds of boric acid and jargonia, if it were not that there is a similar series in the case of the natural crystalline silicate. Some of the jargons from Ceylon have a specific gravity very little inferior to that of pure zircons (4·70), and contain very little jargonia; but those of low gravity (4·20, or thereabouts) contain perhaps nearly 10 per cent, in a state which gives scarcely any trace of absorption bands. After keeping such at a bright red heat for some time, the specific gravity increases from about 4·20 to 4·60; and, judging from the imperfect data now known, this indicates that the volume of the silicate of jargonia is reduced to about one-half. The hardness becomes somewhat greater, and when examined with the spectrum microscope, the spectrum is found to be entirely changed. Instead of a mere trace of bands, a spectrum is seen which is more remarkable than that of any clear and transparent substance I have ever examined, with thirteen narrow black lines and one broader band.* No such changes occur in zircons free from jargonia, like those from Miask—no absorption bands are developed, and there is no increase in their specific gravity. In all cases this varies simply and directly as the amount of jargonia which passes from one state into the other; and if the bands are very distinct before ignition, the gravity is high and not much altered by heat.

Zircons, in their natural condition, from various localities, vary much in both the absolute and relative amount of these two modifications of jargonia; and there is good reason to believe that this difference in physical state may assist us very materially in determining the temperature at which certain rocks have been formed. Fortunately, I have met with one example of the third form of spectrum. A brown-red zircon, from Ceylon, was so dark in one part that I was not able to ascertain what sort of spectrum it would give in its unaltered condition. On heating to redness, the whole became a clear pale green; and, without examination with the spectroscope, no one would have suspected any difference between the different portions. That which was originally pale then showed the spectrum usually characteristic of heated jargons, whilst that which was originally very dark showed one entirely different, corresponding exactly with that of the borate deposited in blowpipe beads at a medium temperature. It also corresponds in general character, but not in detail, with that of the blue spinels from Ceylon, which I believe contain a small quantity of jargonia. That part of the zircon which gives this spectrum appears to have had the same remarkably low specific gravity of about 4·0, both before and after ignition, as though the volume of the silicate of jargonia in this state were even greater than in that which gives no bands.

These various spectra of jargonium are all of a very marked character, quite unlike those due to any other element in similar conditions.

The change produced by heating the jargons is, to some extent, analogous to what occurs on heating arragonite, but yet differs in many most important particulars. When arragonite is thus changed into calcite, it becomes an opaque mass of small crystals, the specific gravity and hardness are diminished, and there is no difference in the spectra of these two different modifications of carbonate of lime; whereas, after heating, the jargons are still as simple and transparent crystals as at first, the specific gravity and hardness are increased, and the spectrum totally changed. Iodide of mercury is an excellent illustration of a difference in the spectrum due to a change in the crystalline state, produced by heat; but there are only two modifications—the scarlet and the yellow. The existence of three crystalline conditions is, in some respects, analogous to what occurs in titanic acid. Anatase, brookite, and rutile are three distinct crystalline modifications of the same substance; but they do not differ very much in specific gravity, and their spectra do not present any characteristic differences. On the whole, the different states of carbon—charcoal, graphite, and diamond—are, perhaps the best illustration of the existence of three distinct modifications, which differs much in specific gravity and optical characters; since one is black, the second has a metallic lustre, and the third is colourless and transparent; but these are variations in the element itself, and not, as in the case of jargonium, modifications

* June 30th.—I have since been able to examine these spectra with unusually good light, and have found another band in the blue in spectrum Fig. 1, and another in the extreme red in spectrum Fig. 2.

* Chemical News, vol. xix., p. 122 (*Am. Repr.*, *May*, 1869, *page* 232).

of its compounds. So far as I am aware, there is indeed, no substance which shows strictly comparable facts.

There cannot, then, I think, be any doubt whatever that jargonium is not only a new elementary substance, but is, also, one likely to throw much light on several important physical questions. By the time that the Royal Society resumes its meetings, I trust that I shall be able to send a complete account of the whole of my investigations, including such facts connected with other substances as may serve to illustrate the very peculiar properties of this hitherto unrecognised element.

Postscript (June 16th).

Since Professor Church has published some papers on the existence of a second earth in some zircons, it may perhaps be well to give a short account of what he has done. He was the first to observe the absorption bands, and gave an account of them in the *Intellectual Observer* for May, 1866 (vol. ix., p. 201). In that paper he said nothing about a *new* elementary substance, and does not even seem to have been convinced that they were not due to zirconia, since he speaks of silica as "the other constituent of zircons," as though there were but two constituents—silica and zirconia. However, since he had found that some zircons show the bands much better than others, he said that he was "induced to hazard the conjecture that it may be, after all, the presence of Svanberg's *norium* which determines the difference." I have now shown that jargonia may exist in very considerable quantity in zircons in such a physical condition as not to show any bands, and it was quite as probable that their presence or absence might have been due to a similar variation in the physical state of zirconia itself; and therefore no fact described in Professor Church's paper can now be looked upon as proof of the existence of a second earth. His paper does not appear to have attracted much attention, and I was quite ignorant of it until after I had printed, for distribution at the *soirée* of the Royal Society on March 6th, an account of the characteristic peculiarities of jargonia. Up to that time he had never so much as even suggested the existence of a *new* earth, and the first time that he did so was in his paper subsequently published in the Chemical News of March 12th (*Am. Repr., May, 1869, page* 231), manifestly written because he had "heard, when in London, that Mr. Sorby had discovered a new set of black absorption bands in certain zircons, and had attributed their occurrence to the presence in the stones examined of a new element accompanying zirconium." In this paper he suggested that the name *nigrium* might be appropriately adopted, but did little more than recapitulate the arguments previously brought forward by Svanberg in proof of the existence of *norium*, viz., a difference in the specific gravity of the zircons, in the atomic weight of the earths, and in some obscure and doubtful chemical properties; but he never proved that the bands might not have been due to several well-known elements, and that the above-named differences depended on the substance which gives the peculiar spectrum. I therefore maintain that I was the first, not only to suggest, but also to prove, the existence of a new element by my blowpipe methods, and to show that the earth may be separated from zirconia and obtained in a state of approximate purity.

Postscript (June 18th).

I here subjoin a brief account of the methods employed by Mr. David Forbes* and myself in separating zirconia and jargonia from one another. He separated apparently pure zirconia by means of strong hydrochloric acid, which dissolved the chloride of jargonium, but left chloride of zirconium undissolved, and obtained the approximately pure jargonia by adding to the solution excess of ammonia, and then considerable excess of tartaric acid, which left most of the tartrate of jargonia insoluble, but dissolved what may turn out to be a mixture of zirconia and jargonia with a third substance not yet sufficiently studied—perhaps Svanberg's noria. My own analysis was only qualitative. I fused powdered jargon with several times its weight of borax, which gave a perfectly clear glass, completely soluble in dilute hydrochloric acid. After separating the silica in the usual manner, a slight excess of ammonia was added to the hydrochloric acid solution of the earths, and then some oxalic and hydrochloric acids, which left undissolved apparently pure zirconia that had passed into an imperfectly soluble state. To this solution so much ammonia was added as to give a very copious precipitate, but yet to leave the solution with a very decided acid reaction. After removing the precipitate, which was chiefly oxalate of zirconia, almost or quite free from jargonia, excess of ammonia was added to the solution, and the washed precipitate digested in dilute hydrochloric acid to remove peroxide of iron. The insoluble portion must have been approximately pure oxalate of jargonia, for it gave the characteristic spectra described above in remarkable perfection. Though this method succeeded far better than I anticipated, I do not yet understand the exact conditions requisite to ensure success, and have been prevented by absence from home from making further experiments.

ON HEAT TREATED AS A SCIENCE OF KINETICS.†

BY G. F. RODWELL, F.C.S.

We are surrounded by actions which we cannot readily recognise. There are actions of the nature of those which constitute light—differing not in kind, and but slightly in degree—which are unseen; there are other actions, similar to those which constitute sound, which are unheard; and others, again, similar to those which constitute heat, which are unfelt. Vast ranges of phenomena are beyond the direct cognisance of the senses. The organs by which external impressions are received and conveyed to the brain, although admirably perfect, —I need not say far *more* perfect than our most delicate and refined instruments—are yet, be it remembered, exercised solely in regard to the welfare of the organism of which they form a part. They are devoted to that organism, and exist for the purpose of enabling it to resist adverse assaults, whether of external agencies, or otherwise; to comply with all the demands requisite for the conditions of life, and to transform the external actions of the material world into actions capable of being recognised under some definite form by the centre of perception—the brain. The actions, or motions, which are thus received and transmitted by the nerves, are such alone as are requisite for the well-being of the entire organism. Light, sound, and heat are va-

* Chemical News, vol. xix., p. 277 (*Am. Repr., Aug., 1869, page* 71).

† A course of four lectures delivered at the London Institution.

rieties of motion; but the nerves of seeing, hearing, and feeling only transmit certain of those motions: if they pass a well-defined limit of quickness or slowness, they cease to be transmitted. But these same relatively quick and relatively slow motions, although incapable of being directly recognised by us, do not the less profoundly influence matter. It is the object of natural philosophy to investigate *all* the actions by which matter is influenced.

Thus our senses are limited in their capability of observation. Their operations are finite. Hence, when we pass from the influence of the so-called *physical forces*—light, heat, electricity, chemical action—upon ourselves to their influence upon matter external to ourselves, it is necessary for us to assist and exact the capabilities of the senses in the particular direction required, and to free the intellect from impressions produced by unaided observation, the bias so resulting, and from the *idola specus* of which Bacon speaks, for we have all of us in our minds "*specum sive cavernam quæ lumen naturæ frangit et corrumpit.*" It therefore behoves us when we study natural philosophy—specially any branch of it submitted to a mode of treatment more assimilable with reason, but less so, perchance, with unaided observation than some older and long-dominant system—it behoves us, I say, to receive with caution, and to carefully examine and analyse the impressions conveyed to us by our unassisted senses, and to put from our minds all preconceived notions, whether derived from directly-received impression, or indirectly from the authority of some older physical system; and this I will ask you to do at the outset. And when, as will frequently be the case, I shall have to speak to you of minute, invisible particles or molecules of matter, endued with functions, attributes, and influences, diverse in form, and varied in character, and such alone as we are wont to associate with larger masses of matter, capable of being seen, and handled, and weighed, I will ask you to grant me some faith, and some imagination. If you find difficulty in doing this in this particular direction, remember that every grain of sand upon the sea-shore is a microcosm, sharing in the innate motions which pulsate through the Universe; and remember, further, that there are specks, infinitely smaller than grains of sand, in which a heart beats, and blood circulates, and all the functions of an exuberant vitality are exercised; and thus, by comparing the unknown with the known, faith may be lessened, and imagination not too tensely stretched.

I had intended to have adopted a different name for the subject of this course from that which appears on the syllabus; to have replaced the word *heat* by some term which, as I thought, would better associate in your minds the idea of motion with that of heat; such as *thermo-kinetics* (from θερμος, heat; and κινησις, motion), or *thermo-dynamics;* or to have spoken of it as *a certain motion appertaining to matter.* I had intended to have done this, when, on enquiring into the etymology of our word *heat*, I found that the term is peculiarly appropriate, although the science which it designates has, of late, undergone the most profound changes. The word *heat* is closely related to the Anglo-Saxon *haets*, the Gothic *haitan*, the Icelandic *hita*, and the old High German *eit;* and these words agree, by Grimm's law, with the Greek αιθος, fire, from αιθω, to kindle; mark, also, the related words αιθοψ, αιθυσσω, and (perhaps) αιθηρ. The celebrated philologist, Bopp, carries back the derivation to a Sanskrit root—*indh*, to shine; and traces it through the Greek αιθος, the Latin *æstus*, and the old High German *eit*, to our word *heat*. "*Æstus*," says Vossius, in his "Lexicon Etymologicon," "*est commotio, vel in igne, vel in aqua, vel in animo. Omnis autem commotio fervorem gignit.*" Now, as it will be my object to show that heat *is* a commotion of the small particles or *molecules** of matter, I think you will agree with me that the term could not be changed with advantage.

From an early age, the idea of motion has, in some form or other, been associated with that of heat. I may remind you that, in αιθυσσω, to put in rapid motion, to kindle (from αιθω), we have distinct reference to this; and, moreover, that αιθηρ, from which we have our word *ether*, was sometimes used to express fire. From the supposed proximity of the sphere of ether to the sphere of fire, and the generation of the latter from the former, the ether was sometimes regarded by the ancients as a very pure fire; invisible, all-pervading, and in perpetual motion; indeed, as a something approaching to the nature of what we now call heat. Now if, as Aristotle affirms, αιθηρ is derived from αει, always, and θεω, to move swiftly, we have here additional evidence that, at an early period, the idea of motion was associated with that of heat.

"*Æstus est commotio . . . omnis commotio fervorem gignit.*" I will define heat as a rapid motion of molecules of matter. This motion, when transmitted to the brain by the molecules of the sensory nerves, produces in us the sensation by which heat is familiarly known.

Let us now briefly trace the rise of the two theories which for so long a time prevailed in regard to the nature of heat. Epicurus regarded heat as an effluxion of minute spherical particles which, in virtue of their smallness, and of the rapidity of their motion, insinuate themselves into the densest substances, and thus expand, and eventually disintegrate them. Lucretius, who followed Epicurus somewhat closely, maintained that both light and heat are caused by the vehement motion of small primary particles—*primi minuti*, as he calls them. The majority of the ancient philosophers regarded fire (under which term was included both light and heat) as an element more divine than air, water, and earth; it was to them the acting agent of the Universe, the *force* exercising itself upon *matter*. The function of fire is well signified in the story of Prometheus, who, you will remember, is related to have stolen fire from heaven, and therewith vivified mankind. Fire was the *anima*, while tangible matter was the *corpus*.

The ideas of the ancients regarding the nature of heat were very generally adopted during the middle ages. Cardanus frequently speaks of *motus ignis* and *motus caloris*. Telesius, of Cosenza, a philosopher far in advance of his time, asserted that heat is the cause of motion, cold of rest, and that these principles together produce all the phenomena of the universe. Robert Fludd (also known as Robertus de Fluctibus), the founder of the Fluddists, affirmed that heat is the ultimate effect of the action of light, and that it results from the motion of material particles. Francis Bacon was one of the first to deny the elemental nature of fire, by asserting that it is "merely compounded of the conjunction of light and heat in any substance;" elsewhere he defines heat as "not an expansive motion of the whole, but of the small parts of a body." As an example of the production of heat by the transforma-

* *Molecula*, a little mass; a Low Latin diminutive of *moles*, a mass; a mass of incommensurable minuteness.

tion of visible motion, he mentions that a piece of metal when hammered becomes hot, and that if the hammering were continued, it would possibly become red-hot.*

About twenty years after the death of Bacon, the *Principia* of Descartes appeared. In it we find the development of one of the most comprehensive kinetic systems which has ever appeared in the history of science. (By *kinetic system* I mean a system in which the phenomena of the universe are accounted for on the supposition that they are caused by various motions.) It is impossible at the present time to enter into any detailed account of the Cartesian philosophy. I may mention, however, that Descartes supposed the existence of three elements, by the mutual interaction of which all natural phenomena are produced. The first element, the *materia cœlestis*, corresponding somewhat to the αιθηρ of the Ancients, is a very subtle medium, possessing perpetual and vehement circular motion, and it is the cause of all the motion in the universe; the second element is more gross, and it embraces all gaseous matter, while the third element embraces all solids and liquids. Thus the first element, which actuates by its motion the second and third elements, corresponds somewhat with what we now call a *force*. Heat, according to Descartes, is a rapid circular motion of the particles of the third element, communicated by the materia cœlestis. The particles of oils and fats, and of combustible bodies generally, are peculiarly adapted to the reception of this motion, and such bodies he designated "potentially hot." Among other passages which bear upon the kinetic theory of heat, I find the following in the fourth book of the *Principia*:—"A nail which is being driven into a block of wood does not become hot until after it has been driven home by the hammer, because heat is not a motion of masses, but of small particles, and so long as the nail itself is capable of moving, the force of the blow is expended in producing the motion of a mass, not in moving the small particles of the metal." The nature of heat, according to the Kinetic theory, received a very apt expression in the following definition given by John Locke:—"Heat is a very brisk agitation of the insensible parts of the object, which produces in us that sensation from which we denominate the object hot; so that what in our sensation is *heat* in the object is nothing but motion."

Towards the close of the seventeenth century, there arose a theory which endeavoured to trace the cause of a number of phenomena to the absorption or rejection of "*materia aut principium ignis, non ipse ignis*," better known as the theory of Phlogiston (from φλογιστος, burnt). This theory profoundly influenced the scientific world for more than a century, and it led to an extended theory of materialised heat.

We thus perceive that there had gradually arisen two distinct theories in regard to the nature of heat, for while some regarded it as a motion of the molecules of matter,—as a condition, or attribute of matter, others regarded it as matter itself, subtle indeed, and infinitely thin, but yet a kind of matter capable of being absorbed or rejected by other and grosser matter. The former of these is the *Kinetic theory of heat*, (κινησις, motion), and is now generally, if not universally, adopted; the latter is the *material theory of heat* (*materia*, matter), and it was almost universally adopted during the last, and far into the present, century.

According to the materialists, substances have heat stored up in them. A metal becomes hot when it is hammered because its particles are approximated, and the heat is, as it were, squeezed out of it, as water is squeezed out of a sponge. The metal, before being hammered, was said to possess a *greater capacity for heat* than the hammered metal. In a similar manner they accounted for the production of heat by friction and percussion; the possibility of procuring new heat was denied, and the amount in the universe was considered incapable of variation.

In 1798, Count Rumford, while engaged in the boring of cannon in the Arsenal of Munich, observed, with surprise, the large amount of heat which was produced during the process, and the apparently unlimited extent of its production. Now, he reasoned, if the explanation of the materialists be correct, it follows that all the heat observed in the cannon, and in the separated borings, results from the altered capacity for heat of a few ounces of metal borings. But, on examination, they were found to possess precisely the same capacity for heat as an equal weight of the solid metal, hence the explanation offered by the materialists was clearly fallacious. Rumford afterwards constructed a special machine for the production of heat by friction. It consisted of a metal cylinder in which a blunt steel borer was caused to revolve by horse-power. The cylinder was surrounded by a casing, in which was placed about 2½ gallons of water. When the borer was caused to revolve, the temperature of the water gradually rose, until, in two hours and a half, the whole quantity of water commenced to boil—a conclusive proof of the unlimited production of heat by mechanical means. A few years later, Sir Humphry Davy conclusively proved the immateriality of heat, by demonstrating the liquefaction of two pieces of ice submitted to friction in a freezing atmosphere. Now, it was admitted—even by the materialists, who contested every inch of ground—that water possesses more heat than ice at the same temperature, hence, if their explanation were valid, ice ought not to liquefy when submitted to friction in a freezing atmosphere.

Although the fallacy of the material theory was thus proved early in the century, the theory was by no means abandoned, and it continued to be generally adopted (when *any* theory at all of heat was adopted), until it was shown that a definite relationship exists between heat and mechanical work, and that they are mutually convertible. This determination of the so-called *mechanical equivalent of heat* was made almost simultaneously by Dr. Julius Mayer, of Heilbronn, in Wurtemburg, and by Mr. Joule, of Manchester, in the

* Some time ago a correspondent enquired in this journal if iron could really be hammered until it becomes red-hot, and some discussion was elicited on the subject, the general conclusion appearing to be that it is one of the many things which are much talked of, but never seen. I recently asked a blacksmith if he could do it, and he replied that he had never seen it done, but would try. In the first place a piece of very tough iron was hammered with a moderately heavy hammer; it became hot, but scarcely sufficiently so to scorch a piece of paper upon which it was placed. It was then hammered by two men, one of whom used a sledge hammer but the iron scarcely became hotter than before. Presently a man who was working in the shop said he had often lit his forge fire by the means when matches were less plentiful than now, and he accordingly took a nail, such as is used for shoeing horses, and after hammering with a light hammer for less than two minutes, part of the nail was brought to a bright red heat. It thus appears that there is a good deal of knack in the operation; the blows were light but frequent, and the nail was turned at each blow, with something of the alternating motion which is adopted in feathering an oar; that is, if we suppose the nail to be square, it was turned, so as to receive one blow upon a surface A, the second on a contiguous side B, the third on A again, and so on, these two surfaces being struck alternately. A few months ago I say a heavily laden omnibus rapidly descending Pentonville-hill with a locked wheel; before reaching the bottom of the hill the bearing surface of the locked wheel was glowing with a bright red heat, and the adjacent woodwork was on fire.

year 1842. Mayer worked out his result rather by reasoning upon known facts than by direct experiment, while Joule instituted a lengthy and elaborate series of experiments, which were published in their entirety in 1850. Since this date, the kinetic theory of heat has been largely developed by the labours of Hirn, Helmholtz, and Sir William Thomson, and notably by Professor Clausius, of Zurich.

Let us now turn our attention to Joule's determination of the relationship existing between heat and mechanical work, or, more correctly, and in accordance with the definition of heat with which we started, of the amount of mass motion equivalent to and convertible into a definite amount of molecular motion. In this country, the unit of mechanical work (known as the *foot-pound*) is the mechanical force necessary to lift 1 lb. to a height of 1 foot *in vacuo*, and the unit of heat is the quantity of heat necessary to raise 1 lb. of water 1° F. in temperature strictly from 55° to 56° F. On the Continent, the unit of work (called a *kilogrammetre*) is the mechanical force necessary to lift 1 kilogramme to a height of 1 metre *in vacuo*, and the unit of heat is the quantity of heat necessary to raise 1 kilogramme of water from 0° C. to 1° C. Sometimes the quantity of heat necessary to raise 1 lb. of water from 0° to 1° C. is adopted as a unit of heat in this country.

Now the simplest and most definite form of mechanical force is the falling of a known weight through a known space under the influence of the force of gravity; and this form of force was employed by Mr. Joule to produce heat by friction. A falling weight was caused to communicate rotary motion to a paddle working respectively in water and in mercury, and to produce the revolution of cast-iron discs in contact; and the increase of temperature resulting from the friction was measured by thermometers which could be read to 1-200 of a degree Fahrenheit. The rise of temperature for each experiment was—in the case of water, 0·563° F.; mercury, 2·41° F.; and cast-iron, 4·3° F.* By this method, Joule ascertained that a weight of 1 lb, falling from a height of 772 feet, produces, on its collision with the earth, an amount of heat competent to raise the temperature of 1 lb. of water 1° F. (that is to say, to generate one unit of heat). Mayer, by a perfectly distinct method, found the number to be 771·4 feet—a difference of less than 0·1 per cent; hence there can be no doubt concerning the accuracy of the determinations.

Let us next consider the various modes by which heat may be generated—the various causes which tend to produce a rapid motion in the molecules of matter; and this brings us at once to the subject of *energy*.

Energy (ενεργεια, action, operation) is a term used in physics to designate the power of doing work against or overcoming the action of force, whether it be— (α) the attraction of masses acting through a sensible space (*gravity*); (β) the attraction of similar molecules acting through an insensible space (*cohesion*); (γ) the attraction of dissimilar molecules acting through an insensible space (*chemical affinity*); (δ) the attraction of molecules in different electrical or magnetic conditions (*electrical and magnetic attraction*), or any action whatsoever which it may be possible to resist. In fact, we may attach to the term energy almost the same meaning as it possesses when applied to ourselves. Energy is competent to exist in two conditions; viz., as *potential energy*, or possible energy; and as *kinetic energy*, or actual energy; and these may be likened to energy of character, and to energy of action in ourselves.

Potential energy, or energy of position, or possible energy, or, as Helmholz calls it, energy of tension, is energy existing in possibility, not in act, as in the case of a ball suspended above the surface of the earth, or an arrow resting upon a tense bow-string.

Kinetic energy, or energy of motion, or dynamic energy, or *vis viva*, or mechanical energy (for by these various names you will find it designated in different books), is the actual energy of a body in motion; as in the case of a ball falling to the earth's surface, or an arrow projected from a released bow-string.

Now, when the kinetic energy of a mass is suddenly arrested—as by collision with a larger mass—it is transformed into the motion of molecules—it becomes heat; and it has been found that the heat thus produced is dependent upon the mass of the moving body multiplied by the square of its velocity, that is, $h=mv^2$. From this, it follows that, if the velocity of a projectile be doubled, the heat developed on the stoppage of its motion will be increased fourfold; if trebled, ninefold; if quadrupled, sixteenfold; and so on. It has thus been calculated that a rifle-bullet, moving with a velocity of 1338 feet per second, develops, upon striking the target, sufficient heat to raise its temperature 1080° F., an amount more than sufficient to fuse it; but we must remember that this heat is shared between the bullet and the target. But, in the application of this law, we may pass from the arrested motion of a rifle-bullet to that of far larger masses of matter. Mayer and Helmholtz have calculated the amount of heat which would be produced by the stoppage of the earth in its orbit, and have determined that it would be sufficient not alone to fuse, but actually to vaporise the earth. The heat thus generated would be equal to that produced by the burning of fourteen spheres of coal, each equal to the earth in magnitude.

The amount of energy in the Universe is constant; we can neither add to it nor take from it; the only possible change is from one form to another; and this is called the principle of the *conservation of energy*.

Potential energy is constantly being converted into kinetic energy, and kinetic energy as constantly into heat. Friction, percussion, and compression, and the partial or complete stoppage of motion in any form, and by any means whatsoever, afford examples of this. (I.)—*By Friction.*—Lucretius tells us that fire was first made known to mortals, either by clouds meeting violently in collision and dashing out sparks of fire, or by the excessive friction of the branches of trees in a forest, induced by high winds, and resulting in fire. Friction has, from the earliest ages, been employed as a means of producing fire, and in our modern matches, although the labour is lessened, we still adopt the means. (The many experiments which illustrate this part of the subject are too well known to need detail here. Phosphorus may be readily ignited by the heat of friction (α) of a pointed piece of wood rubbed in a wooden groove; (β) of a gimlet which has been used for boring wood, or (γ) of a saw which has been used for sawing; (δ) by the heat resulting from the friction of the crystalline fibres of tin, by bending a rod of that metal repeatedly in opposite directions; and a number of examples will

* If water be violently shaken in a bottle for less than a minute, a rise of temperature of from 0·7° to 0·8° F. ensues; and in the case of mercury, of from 1·3° to 1·5° F. Of course, in both cases, if the bottles are shaken by the hand, they must be surrounded by several layers of thick flannel, to prevent any communication of heat from the hand. Mr. Herschell has ingeniously shown the heating of mercury by agitation by communicating rapid reciprocal motion to a tube containing a small quantity of that metal, and then placing a piece of phosphorus on its surface: immediate ignition is the result.

suggest themselves at once without further mention.) (II.)—*By Percussion.*—A piece of metal when hammered becomes hot, and may readily be brought to a red heat. When a pistol is cocked, potential energy is conferred upon the hammer; it is comparable to a raised weight: when the trigger is pulled, the potential energy becomes kinetic; when the hammer strikes the cap the kinetic energy becomes heat equal to that expended in raising the hammer. (III.)—*By Compression.*—A piece of wood, compressed in an hydraulic press, becomes warmer than before. In the rolling of the metals (as at the Mint), the bar, before passing between the rollers, is cold, but, after compression, it comes out so intensely heated that water assumes the spheroidal condition when poured upon it. (IV.)—*By Chemical Action.*—The production of heat by chemical action is probably due to the conversion of the kinetic energy of molecules into heat, as in the above instances, the heat resulted from the conversion of the kinetic energy of *masses.* (Instances of the production of heat by chemical action are too numerous to require notice here; take the combination of sulphuric anhydride with water, or of iodine with phosphorus, as examples.) Molecules, chemically separated, are in the condition of a raised weight, the energy which has been expended in separating them has overcome the force of chemical attraction, and removed the molecules out of its range; when they once again come within the range of the attraction, they rush together and unite chemically; their potential energy becomes kinetic, and the kinetic energy becomes heat. (V.)—*By Electricity in Motion.*—When kinetic electricity passes through a thin wire which offers some resistance to its passage, heat is copiously produced. (The production of heat by the energy of electricity in motion cannot be accounted for until we know more of the nature of electricity. Possibly, in the above experiment, the electricity so agitates the molecules of the conducting wire that, while transmitting its own motion, a collision of molecules results, and a consequent production of heat; or, in other words, the electricity may indirectly confer kinetic energy upon the molecules of the conducting wire, which energy is resolved into heat.)

The reverse of the above action also takes place. Heat is consumed—(α) in the production of mechanical work as in heat engines, the most prominent example of which is the steam-engine; (β) in the separation of molecules chemically united, as in any instance of decomposition by heat; and (γ) in the production of kinetic electricity, as in the thermo-electric pile. Mayer, writing in 1842, says: "A locomotive may be compared to a distilling apparatus; the heat applied under the boiler passes off as motion, and this is deposited as heat at the axles of the wheels."* Sparks may be frequently observed at the point of contact of the break-wheels and the rail at any of the "Metropolitan Railway" stations. The trains on this line keep up their speed until they are on the point of entering the station, hence their motion is more suddenly arrested than that of trains in general, and hence the above result. The loss of molecular motion (cold) which results from the performance of work, may be readily shown by causing a gas to perform work, as when the receiver of an air-pump is rapidly exhausted, the production of cold is shown by the deposit of moisture upon the sides of the receiver; it may also be readily shown by a Breguet's helix; or, again, when a cork is projected from a soda-water bottle, cold results. The condition of the cork at any moment can be clearly defined by bearing in mind that which has been said above on the subject of energy. At the outset the cork is in a condition of potential energy, for it has a greater pressure upon its under than its upper surface, and is hence competent to do work against gravity; when the string is cut, the potential energy becomes kinetic, and the cork is projected into the air. At any moment of its flight before attaining the final altitude, it possesses both potential and kinetic energy, for it possesses potential energy capable of causing it to fall through the space intervening between it and the earth, *plus* the kinetic energy which will raise it to the final altitude; when the latter is attained, the energy is obviously all potential, and the potential energy is not entirely transformed into kinetic until the cork reaches the earth; on its collision, heat is produced equal to that consumed in projecting it from the bottle.

* "On the Forces of Inorganic Nature." These essays were translated a few years ago, and were published in the *Philosophical Magazine.*

II. (Abstract).

In this lecture, some of the effects of heat upon matter were discussed, commencing with expansion, and the experiments which illustrate this part of the subject were shown (such as the unequal of a compound bar, S'Gravesande's ball, and the various appliances by which liquids and gases can be shown to expand, as the alcohol and mercury thermometer, Galileo's air thermometer, Leslie's differential air thermometer, and so on). The intensity of the attractive force exerted by similar molecules acting through an insensible space (cohesion) was shown by the breaking of a bar of iron by the contraction of a metal bar during cooling.

The following definitions are taken for the most part from the lecture notes:—

"*Æstus est commotio . . . omnis commotio fervorem gignit.*" Heat having been defined in the last lecture as a motion of the small particles, or molecules of matter, it is obvious that the addition of this motion to a congeries of molecules must cause them to occupy a greater space (*expansion*); while the subtraction of this motion must cause them to occupy a less space than before (*contraction*).

In virtue of this, heat determines the form which matter assumes. In solids, the attraction of the molecules for each other (sometimes called *cohesion*, from *cohæreo*, to stick together), greatly predominates over the molecular motion, and, by limiting the range of movement, keeps them comparatively close together. In liquids, there is a greater amount of molecular motion; hence the range of movement of the molecules is extended; the cohesive force is lessened by the distance, and the molecules have a less restrained motion. In gases, there is a still greater amount of molecular motion: the molecules move at such a distance from each other that their individual attraction becomes a vanishing force; hence they are absolutely unrestrained in their motion. Thus, in the passage from solidity to gaseity, there is a progressive decrease of cohesive force, arising from a progressive augmentation of the space between the attracting molecules, and a progressive increase of molecular motion, arising from direct addition; while in the passage from gaseity to solidity, there is a progressive increase of cohesive force, arising from the diminution of the space between the attracting molecules, and a progressive decrease of molecular motion, arising from direct transference.

An increase of external pressure will obviously tend

to approximate the molecules of matter; and hence, *à priori*, will, to some extent, produce the same result as a subtraction of molecular motion; while a decrease of external pressure will afford the molecules a greater range of movement, and will hence produce the same result as an addition of molecular motion. Thus certain gases are liquefied by increasing the pressure (for example, chlorine and sulphurous anhydride), and certain liquids are gasefied by the removal of the existing pressure (for example, ethers having low boiling points, and, *à priori*, the liquids of gases liquefied by pressure).

We do not know the nature of the motion which constitutes heat. According to an hypothesis, which is ably supported, the molecules of solids and liquids move circularly around a centre, while the molecules of gases move in right lines. Thus a solid becomes liquid, in the language of this hypothesis, when the amplitude of the oscillation of its molecules passes a certain limit; and a liquid becomes a gas when its molecules fly off at a tangent to the circles in which they previously moved. This hypothesis is eminently Cartesian in its tone and character. (Examples of the passage of circular into tangential motion may be frequently observed—notably in the water which is projected from a trundled mop, in the sparks which fly off from a Catherine wheel, in the mud projected from the periphery of a rapidly-moving carriage wheel, and in a stone hurled from a sling. This last example is frequently adduced by Descartes (see his *Principia Philosophiæ*, pars. 2, cap. 39, entitled, "Altera lex naturæ, quod omnis motus ex se ipso sit rectus, et ideo quæ circulariter moventur, tendere semper ut recedant a centro circuli quem describunt;" and again, pars. 3, cap. 57 and 58). As a lecture experiment, it may be shown by attaching a small wooden ball to a spring (a helix of brass wire answers the purpose well), and communicating circular motion by whirling it in a vertical plane, either by the hand, or by a whirling table. As the velocity of revolution increases (analogous to the increased molecular motion induced by heating), the ball recedes from the centre of revolution (analogous to the act of expansion), until, at a certain maximum of rapidity, the ball may be released, or may be caused to break the spring, when it of course assumes a rectilinear motion (analogous to the passage of a liquid into the gaseous condition); or the helix of brass wire may be replaced by a piece of india-rubber tubing, to one end of which the ball may be fastened by a movable pin, worked by a string, which passes through the axis of the tube and is held by the hand. The revolution is commenced, and, when at its maximum, the string is pulled so as to dislodge the pin, and thus release the ball, which immediately changes its circular for tangential movement; or, again, rapid circular motion may be communicated to a very shallow bowl containing water, and the velocity augmented until the particles of water fly off tangentially.

Heat is usually measured by the expansion of a liquid or gas, it having been found that equal additions of molecular motion produce, (α) in the case of gases, equal alterations in bulk, irrespective of the nature of the gas; (β) in the case of liquids, nearly equal alterations in bulk in the same liquid, although different alterations in different liquids. (*Thermometry*, θερμος, heat; μετρον, a measure.)

A *degree of heat* is an arbitrary quantity, and it may be defined as the amount of molecular motion which is competent to increase the bulk of a certain quantity of specified matter to a certain known extent. A *unit of heat* was defined in the last lecture.

The *co-efficient of expansion* of a substance is the increase in length (*linear co-efficient*) or in bulk, (*cubical co-efficient*), produced by the assumption of a certain amount of molecular motion, by a substance whose length or bulk was known when it possessed a certain less amount of molecular motion, in both cases measured as described above. Thus, if the length of a brass rod at the freezing point of water (32°F.) be taken as 1·000000, its length at the temperature of boiling water (212° F.) will be found to be 1·001867, and the linear co-efficient of expansion of brass for 212°—32°F.=180° F. is hence 0·001867, and for 1° F.=$\frac{0{\cdot}001867}{180}$=0·00001038.

Evaporation (*evaporo*, to disperse in vapour), is the conversion of a liquid into gas at its exposed surface. The molecules at the surface, unlike those in the mass of the liquid, are influenced and restrained by the proximity of other molecules, *in one direction only;* hence, in the language of the hypothesis mentioned above, they more readily assume the rectilinear motion appertaining to the molecules of a gas.

Ebullition, or boiling (*ebullio*, to boil or bubble up), is the conversion of a liquid into gas by the assumption of rectilinear motion by the molecules in the interior of the liquid mass. The liquid continues to receive molecular motion until the cohesion of its molecules (plus or minus any of the extraneous actions mentioned below) is overcome; the molecules thus freed from restraint, part company with the liquid in the form of bubbles of gas. The temperature at which this takes place, subject to the conditions which at that time prevail, is called the *boiling point* of the liquid under those conditions.

The boiling point of a liquid is influenced by the following extraneous causes:—(α), external pressure, which, by limiting the motion of the molecules, and thus assisting cohesion, raises the boiling point; (β), the substance of the containing vessel, between which and the liquid molecules a certain attraction, differing for different substances, exist, which consequently assists cohesion, and raises the boiling point; (γ), dissolved substances, which in the case of dissolved solids tend to raise the boiling point, and in the case of dissolved air, to lower it. Thus water boils—(α) at a lower temperature on the summit of a mountain than at its base; (β) at a higher temperature in a glass than in a metal vessel; (γ) at a higher temperature when it contains salt in solution, as in sea water, than when it is free from dissolved solids, as in rain water; and at a far higher temperature when it is freed from dissolved air than when it contains air in solution.

Evaporation in the spheroidal condition is the surface evaporation of a liquid spheroid, floating upon a layer of its own gas, which separates it from direct contact with a surface possessing a higher (usually, but not necessarily, a much higher) temperature.

The spheroid has been proved to be out of contact with the hot surface by various means; thus the light of a flame can be seen through the space intervening between the spheroid and the hot surface, and nitric acid in the spheroidal condition upon a hot plate of copper does not attack it; neither does dilute sulphuric acid act upon zinc under the same conditions. We have analogous actions in the reverse experiment, in which a hot metal is caused to float upon a liquid surface, buoyed up by the layer of gas beneath. Thus, if a light silver ball be heated to whiteness, it will readily float upon the surface of water; and when iron is burned in

oxygen, the globules of molten oxide will frequently float for a second or two upon the surface of the water beneath, or sometimes they will fall through a layer of one or two inches of water, and yet be sufficiently hot when they reach the bottom to fuse themselves into the glass or earthenware tray. Again, the freezing of water and mercury in red-hot vessels is due to the same action: liquid sulphurous acid evaporates comparatively slowly upon a white-hot surface, and when a mixture of solid carbonic acid and ether is poured into a red-hot platinum crucible, it immediately assumes the spheroidal condition, evaporates comparatively slowly, and will readily freeze mercury.

III. (Abstract).

This lecture was chiefly devoted to a consideration of the effects produced by heat within a mass of matter, and the various forms of action which it then assumes. The following definitions, which are taken from the "Notes," convey the principal points of the lecture.

The attractive force existing between the molecules of matter, like all other attractive forces, decreases in intensity as the distance between the attracting molecules increases, and *vice versâ*. Liquids become solids (*solidification*) when they lose so much of their molecular motion that the molecules approach sufficiently near to each other to produce the effects of rigidity, in place of the former molecular mobility. (α). When the resulting solid assumes a definite geometrical form (*crystallisation*), the attractive force of its molecules probably varies in intensity in different directions; thus, supposing the molecules to be spherical, the attractive force would be greater or less in the direction of a diameter A than in the direction of a diameter B, cutting A at right angles; or, supposing the molecules to be ellipsoidal, the attractive force would be greater or less in the direction of the major axis than in the direction of the minor axis. (3). When the resulting solid does not assume a crystalline structure or form, the attractive force of the molecules probably does not vary in different directions, or the varying intensity may be equalised by extraneous causes (*amorphous solidification*).

When molecular motion is communicated to a substance, it is obvious that, before it can expand that substance, it must overcome the mutual attraction of its molecules at the particular distance at which they then exist; for expansion is the act of increasing the distance between individual molecules (*vide* Lecture II.). In thus separating the molecules, there is, consequently, a certain amount of work to be done (*the internal work of a mass of matter*), just as the separation of two masses—for instance, the raising of a weight to a height above the surface of the earth—involves the expenditure of an amount of work equal to the force of gravity which has been overcome, and, in both cases alike, heat is consumed in the performance of the work done. And as when a weight is raised above the surface of the earth it possesses potential energy (*vide* Lecture I.) competent, when converted into kinetic energy, to cause it to fall through the space which separates it from the earth, and to generate the heat consumed in raising it when its kinetic energy is arrested, so, likewise, the molecules of a substance expanded by heat possess potential energy (*molecular potential energy*) competent to cause them to recross the space through which they have been separated by the added molecular motion, and to generate the heat consumed in separating them when the kinetic energy thus induced is arrested.

And since all matter possesses a certain amount of molecular motion, and no two molecules are in contact, it follows that all molecules possess a certain amount of potential energy, and that the acts of heating and cooling (addition and subtraction of molecular motion) may be expressed respectively as the increasing and the lessening of molecular potential energy, considered in regard to its amount at the time of such addition or subtraction. (The first part of this assertion may be otherwise expressed by saying that nothing is so cold that it cannot be made colder; ice may be called excessively hot when compared with solid carbonic anhydride; in a word, the former possesses a far larger amount of molecular motion than the latter. The *absolute zero of temperature* is believed to be —273° C., and we must imagine that the molecules of matter would be in contact at this temperature. Matter thus constituted would be perfectly lifeless and inert; it would possess no motion, neither could its molecules transmit any motion. We have not yet succeeded in producing a degree of cold approaching the absolute zero. The rapid evaporation of liquid ammonia *in vacuo* in the presence of sulphuric acid produces a temperature of 87° C. below zero; liquid nitrous oxide, in becoming gas, reduces the temperature to —88° C.; solid carbonic acid produces a temperature of —90° C., and when mixed with ether and placed *in vacuo*, of —100° C., while the greatest artificial cold has been obtained by the rapid evaporation *in vacuo* of a mixture of liquid nitrous oxide with disulphide of carbon, when the temperature fell to —140° C. By the employment of a freezing mixture of solid carbonic anhydride and ether, simultaneously with excessively high pressures, Andrews has reduced nitric oxide to 1-680th of its original volume, oxygen to 1-554th, and hydrogen to 1-500th, but in no instance did these gases exhibit signs of liquefaction. It is obvious that in the case of compressible matter pressure will tend equally with loss of molecular motion to lessen the molecular potential energy.)

From the above paragraphs it follows that, when molecular motion is added to molecules, it performs two functions, for a portion of it is converted into work (*vide* Lecture I.) which confers potential energy upon the molecules by separating them (*expansion*), while another portion increases the temperature of the substance (*vide* Lecture II.), by conferring upon the molecules a larger quantity of the motion which constitutes heat, and hence increasing their velocity. Thus a portion of the added molecular motion disappears as heat, and this is still known as *Latent Heat*—(*Lateo*, to lie hid, because it was imagined by those who adopted the material theory of heat (*vide* Lecture I.) that the heat thus designated was somehow hidden in the substance, as in a cave, and that it only came out under certain conditions, and this idea was one of the most notable of the many *idola specus* possessed by the Materialists).

The quantity of heat which is thus expended in interior work when a solid passes into a liquid, or a liquid into the gaseous condition, can be readily determined. Thus, if a pound of boiling water (212° F.) be mixed with a pound of ice-cold water (32° F.) the temperature of the resulting two pounds of water is found to be 122° F., that is, the mean of the two:— $\frac{212° + 32°}{2}$ F. = 122° F. But if a pound of ice (32° F.) be mixed with a pound of boiling water, the temperature of the resulting two pounds of water is found to be only 51° F. Now it is obvious that the difference in the total heat

of the two mixtures is that required to raise two pounds of water, 122° — 51° F. = 71° F., or one pound through 142° F. In other words, in the act of liquefying a pound of ice at 32° F., an amount of heat is consumed as internal work which is competent to raise one pound of water through 142° F.; that is to say, 142 units of heat (*vide* Lecture I.), which represents as mechanical work one pound weight raised to a height of 772×142 feet = 109,924 feet (or more than 20 miles) above the surface of the earth (*vide* Lecture I.).

The actual amount of molecular motion possessed by different substances (*specific heat*) varies considerably, for not only do the molecules in a given space vary in quantity, but also in weight, and in their attraction for each other; hence, also, the amount of heat consumed in internal work varies, because it depends upon the relative attraction of the molecules.

The amount of molecular motion necessary to raise any substance through a known number of thermometric degrees (*vide* Lecture II.) compared with that necessary to raise the same weight of water through the same number of degrees, is called the specific heat of that substance. Thus, to raise 1 lb. of water 1° F. in temperature requires thirty-three times the amount of heat necessary to rise one pound of mercury 1° F. in temperature; hence, the specify heat of water being represented by 1·00, that of mercury will be 0·033.

Conduction of Heat is the transference of molecular motion from molecules possessing a certain amount of it to molecules possessing less of it, by direct communication of motion. Those molecules which are apt to receive and transmit the motion are called *conductors* of heat, while those which are unfitted for the reception and transmission of the motion (whether from their slight mobility, or from an inaptitude to accommodate themselves to that kind of motion) are called *non-conductors* of heat.

Convection (from *conveho*, to carry up) is an action induced by external means—the force of gravity—in virtûe of which a congeries of molecules of liquid or gas, possessing a greater amount of molecular motion than surrounding congeries or system of congeries, rises *en masse*, because the motion of heat, by increasing the distance between the molecules of matter (*vide* Lecture II.) causes a given number thereof to occupy a larger space when they possess a certain amount of that motion than when they possess relatively less, whence ensues a difference of density and a consequent difference of action on the part of gravity, for in equal bulks there are now no longer equal weights of matter, and one mass is now attracted by the earth more powerfully than the other.

ADDITIONAL OBSERVATIONS ON HYDROGENIUM.*

BY THOMAS GRAHAM, F.R.S.,

MASTER OF THE MINT.

From the elongation of a palladium wire, caused by the occlusion of hydrogen, the density of hydrogenium was inferred to be a little under 2. But it is now to be remarked that another number of half that amount may be deduced with equal probability from the same experimental data. This double result is a consequence of the singular permanent shortening of the palladium wire observed after the expulsion of hydrogen. In a particular observation formerly described, for instance, a wire of 609·14 m.m. increased in length to 618·92 m.m when charged with hydrogen, and fell to 599·44 m.m. when the hydrogen was extracted. The elongation was 9·77 m.m., and the absolute shortening or retraction 9·7 m.m., making the extreme difference in length amount to 19·47 m.m. The elongation and retraction would appear, indeed, to be equal. Now it is by no means impossible that the volume added to the wire by the hydrogenium is represented by the elongation and retraction taken together, and not by the elongation alone, as hitherto assumed. It is only necessary to suppose that the retraction of the palladium molecules takes place the moment the hydrogenium is first absorbed, instead of being deferred till the latter is expelled; for the righting of the particles of the palladium wire (which are in a state of excessive tension in the direction of the length of the wire) may as well take place in the act of the absorption of the hydrogenium as in the expulsion of that element. It may, indeed, appear most probable in the abstract that the mobility of the palladium particle is determined by the first entrance of the hydrogenium. The hydrogenium will then be assumed to occupy double the space previously allotted to it, and the density of the metal will be reduced to one-half of the former estimate. In the experiment referred to, the volume of hydrogenium in the alloy will rise from 4·68 per cent to 9·36 per cent, and the density of hydrogenium will fall from 1·708 to 0·854, according to the new calculation. In a series of four observations upon the same wire, previously recorded, the whole retractions rather exceeded the whole elongations, the first amounting to 23·99 m.m., and the last to 21·38 m.m. Their united amount would justify a still greater reduction in the density of hydrogenium, namely to 0·8051.

The first experiment, however, in hydrogenating any palladium wire appears to be the most uniform in its results. The expulsion of the hydrogen afterwards by heat always injures the structure of the wire more or less, and probably affects the regularity of the expansion afterwards in different directions. The equality of the expansion and the retraction in a first experiment appears, also, to be a matter of certainty. This is a curious molecular fact, of which we are unable as yet to see the full import. In illustration, another experiment upon a pure palladium wire may be detailed. This wire, which was new, took up a full charge of hydrogen, namely, 956·3 volumes, and increased in length from 609·585 to 619·354 m.m. The elongation was, therefore, 9·769 m.m. With the expulsion of the hydrogen afterwards, the wire was permanently shortened to 600·115 m.m. It thus fell 9·470 m.m. below its normal or first length. The elongation and retraction are here within 0·3 m.m. of equality. The two charges taken together amount to 19·239 m.m., and their sum represents the increase of the wire in length due to the addition of hydrogenium. It represents a linear expansion of 3·205 on 100, with a cubic expansion of 9·827 on 100. The composition of the wire comes to be represented as being—

	In volume.	
Palladium	100·000	or 90·895
Hydrogenium.....	9·827	or 9·105
	109·827	or 100·000

The specific gravity of the palladium was 12·3, the weight of the wire 1·554 grm., and its volume 0·126 cub. centim. The occluded hydrogen measured 120·5

* Read before the Royal Society, June, 1869.

cub. centims. The weight of the same would be 0·0108 grm., and the volume of the hydrogenium 0·012382 cub. centim. (100 : 9·827 :: 0.126 : 0·01238). The density of the hydrogenium is therefore

$$\frac{0{\cdot}0108}{0{\cdot}01238} = 0{\cdot}872.$$

This is a near approach to the preceding result, 0·854. Calculated on the old method, the last experiment would give a density of 1·758.

It was incidentally observed, on a former occasion, that palladium alloyed with silver continues to occlude hydrogen. This property is now found to belong generally to palladium alloys, when the second metal does not much exceed one-half of the mixture. These alloys are all enlarged in dimensions when they acquire hydrogenium. It was interesting to perceive that the expansion was greater than happens to pure palladium, about twice as much; and that, on afterwards expelling the hydrogen by heat, the fixed alloy returned to its original length *without any further shortening of the wire.* The embarrassing retraction of the palladium has, in fact, disappeared.

The fusion of the alloys employed was kindly effected for me by Messrs. Mattey and Sellon, when the proportion of palladium was considerable, by the instrumentality of M. Deville's gas furnace, in which coal gas is burned with pure oxygen; or by means of a coke furnace, when the metals yielded to a moderate temperature. The alloy was always drawn out into wire if possible, but if not sufficiently ductile, it was extended by rolling into a form of a thin ribbon. The elongation caused by the addition of hydrogenium was ascertained by measuring the wire or ribbon stretched over a graduated scale, as in the former experiments.

1. *Palladium, Platinum, and Hydrogenium.*—Palladium was fused with platinum, a metal of its own class, and gave an alloy consisting, according to analysis, of 76·03 parts of the former, and 23·97 parts of the latter. This alloy was very malleable and ductile. Its specific gravity was 12·64. Like pure palladium, it absorbed hydrogen, evolved on its surface in the acid fluid of the galvanometer, with great avidity.

A wire 601·845 m.m. in length (23·69 inches) was increased to 618·288 m.m, on occluding 701·9 volumes of hydrogen gas measured at 0° C. and 0·76 barom. This is a linear elongation of 16·443 m.m. (0·6472 inch), or 2·732 on a length of 100. It corresponds with a cubic expansion of 8·423 volumes on 100 volumes; and the product may be represented—

	In volume.	
Fixed metals	100·000	or 92·225
Hydrogenium	8·423	or 7·775
	108·423	or 100·000

The elements for the calculation of the density of hydrogenium are the following, the assumption being made as formerly, that the metals are united without condensation :—

Original weight of the wire, 4·722 grms.
Original volume of the wire, 0·373 cub. centim.
Volume of the hydrogen extracted, 264·5 cub. centims.
Weight of the hydrogen extracted, by calculation, 0·0237 grm.

The volume of the hydrogenium will be to the volume of the wire (0·373 cub. centim.) as 100 is to 8·423; that is, 0·03141 cub. centim. Finally, dividing the weight of the hydrogenium by its bulk, 0·0237 by 0·03141, the density of hydrogenium is found to be 0·7545.

On expelling all hydrogen from the wire at a red heat, the latter returned to its first dimensions as exactly as could be measured. The platinum present appears to sustain the palladium, so that no retraction of that metal is allowed to take place. This alloy therefore displays the true increase of volume following the acquisition of hydrogenium, without the singular complication of the retraction of the fixed metal. It now appears clear that the retraction of pure palladium must occur on the first entrance of hydrogen into the metal. The elongation of the wire due to the hydrogenium is negatived thereby to the extent of about one-half, and the apparent bulk of the hydrogenium is reduced to the same extent. Hydrogenium came in consequence to be represented of double its true density.

The compound alloy returns to its original density (12·64) upon the expulsion of the hydrogen, showing that hydrogen leaves without producing porosity in the metal. No absorptive power for vapours, like that of charcoal, was acquired.

The same wire of palladium and platinum, charged a second time with hydrogen, underwent an increase in length from 601·845 to 618·2, or sensibly the same as before. The gas measured 258 c.c., or 619·6 times the volume of the wire. The product may be represented as consisting of—

	By volume.
Fixed metals	92·272
Hydrogenium	7·728
	100·000

The density of hydrogenium deducible from this experiment is 0·7401. The mean of the two experiments is 0·7473.

2. *Palladium, Gold, and Hydrogenium.*—Palladium used with gold formed a malleable alloy, consisting of 75·21 parts of the former and 24·79 parts of the latter, of a white colour, which could be drawn into wire. Its specific gravity was 13·1. Of this wire 601·85 m.m. occluded 465·2 volumes of hydrogen, with an increase in length of 11·5 m.m. This is a linear elongation of 1·91 on 100, and a cubic expansion of 5·84 on 100. The resulting composition was therefore as follows :—

	In volume.	
Alloy of palladium and gold	100·00	or 94·48
Hydrogenium	5·84	or 5·52
	105·74	100·00

The weight of the wire was 5·334 grms.
The volume of the wire was 0·4071 c.c.
The volume of hydrogen extracted, 189 c.c.
The weight of the hydrogen, 0·01693 grm.
The volume of the hydrogenium, 0·02378 c.c.
Consequently the density of the hydrogenium is 0·711.

The wire returned to its original length after the extraction of the hydrogen, and there was no retraction.

The results of a second experiment on the same wire were almost identical with the preceding.

The elongation on 601·85 m.m. of wire was 13·3 m.m., with the occlusion of 463·7 volumes of hydrogen. This is a linear expansion of 1·902 on 100, and a cubic expansion of 5·81 on 100. The volume of hydrogen gas extracted was 188·8 c.c., of which the weight is 0·016916 grm. The volume of the hydrogenium was 0·02365 c.c., that of the palladium gold alloy being 0·4071 c.c. Hence the density of the hydrogenium is 0·715.

In a third experiment, made on a shorter length of

the same wire, viz., 241·2 m.m., the amount of gas occluded was very similar, viz., 468 volumes, and was not increased by protracting the exposure of the wire for the long period of 20 hours. There can be little doubt, then, of the uniformity of the hydrogenium combination, the volume of gas occluded in the three experiments being 464·2, 463·7, and 468 volumes. The linear expansion was 1·9 on 100 in the third experiment, and therefore similar also to the preceding experiments.

The hydrogenium may be supposed to be in direct combination with the palladium only, as gold by itself shows no attraction for the former element. In the first experiment the hydrogenium is in the proportion of 0·3151 to 100 palladium and gold together. This gives 0·3939 hydrogenium to 100 palladium; while a whole equivalent of hydrogenium is 0·939 to 100 palladium.* The hydrogenium found is, by calculation, 0·4195 equivalent, or one equivalent hydrogenium to 2·383 equivalents palladium, which comes nearer to two equivalents of the former with five of the latter than to any other proportion.

To ascertain the smallest proportion of gold which prevents retraction, an alloy was made by fusing seven parts of that metal with 93 parts of palladium, which had a specific gravity of 13·05. The button was rolled into a thin strip and charged with hydrogen by the wet method. An occlusion of 585·44 volumes of gas took place, with a linear expansion of 1·7 on 100. A retraction followed to nearly the same extent on afterwards expelling the hydrogen by heat.

With another alloy, produced by fusing 10 of gold with 90 of palladium, the occlusion of gas was 475 volumes, the linear expansion 1 65 on 100. The retraction on expelling the gas afterwards was extremely slight. To nullify the retraction of the palladium, about 10 per cent of gold appears therefore to be required in the alloy.

Another alloy of palladium of sp. gr. 13·1, and containing 14·79 per cent of gold, underwent no retraction on losing hydrogen, as already stated.

The presence of so much gold in the alloy as half its weight did not materially reduce the occluding power of the palladium. Such an alloy was capable of holding 459·9 times its volume of hydrogen, with a linear expansion of 1·67 per cent.

3. *Palladium, Silver, and Hydrogenium.*—The occluding power of palladium appeared to be entirely lost when that metal was alloyed with much more than its own weight of any fixed metal. Palladium alloys containing 80, 75, and 70 per cent of silver occluded no hydrogen whatever.

With about 50 per cent of silver, palladium rolled into a thin strip occluded 400·6 volumes of hydrogen. It expanded 1·64 part in 100 in length, and returned to its original dimensions without retraction upon the expulsion of the gas. The specific gravity of this silver-palladium alloy was 11·8; the density of the hydrogenium 0·727.

An alloy, which was formed of 66 parts of palladium and 34 parts of silver, had the specific gravity 11·45. It was drawn into wire, and found to absorb 511·37 volumes of hydrogen. The length of the wire increased from 609·601 to 619·532 m.m. This is a linear elongation of 1·629 on 100, or cubic expansion of 4·97 on 100. The weight of the wire was 3·483 grms.; its volume 0·3041 c.c. The absolute volume of occluded hydrogen was 125·1 c.c., of which the weight is 0·01120896. The volume of the hydrogenium was 0·015105 c.c. The resulting density of hydrogenium is 0·742.

In a repetition of the experiment upon another portion of the same wire, 407·7 volumes of hydrogen were occluded, and the wire increased in length from 609·601 m.m. to 619·44 m.m. This is a linear expansion of 1·614 part on 100, and a cubic expansion of 4·92 on 100. The absolute volume of hydrogen gas occluded was 124·0 c.c., and its calculated weight 0·01111 grm. The volume of the hydrogenium being 0·1496 c.c., the density of hydrogenium indicated is 0·741. The two experiments are, indeed, almost identical. The wire returned in both experiments to its original length exactly after the extraction of the gas.

4. *Palladium, Nickel, and Hydrogenium.*—The alloy, consisting of equal parts of palladium and nickel, was white, hard, and readily extensible. Its specific gravity was 11·22. This alloy occluded 69·76 volumes of hydrogen, with a linear expansion of 0·2 per cent. It suffered no retraction below its normal length on the expulsion of the gas by heat.

An alloy of equal parts of *bismuth* and palladium was a brittle mass that did not admit of being rolled. It occluded no hydrogen, after exposure to that gas as the negative electrode, in an acid fluid for a period of 18 hours. It seems probable that malleability and the colloid character, which are wanting in this bismuth alloy, are essential to the occlusion of hydrogen by a palladium alloy.

An alloy of one part of *copper* and six parts of palladium proved moderately extensible, but absorbed no sensible amount of hydrogen. The metallic laminæ which remained on digesting this alloy in hydrochloric acid, and which were found by M. Debray to be a definite alloy of palladium and copper (PdCu), exhibited no sensible occluding power.

The conclusions suggested as to the density of hydrogenium, by the compound with palladium alone and by the compounds with palladium alloys, are as follows:—

	Density of Hydrogenium observed.
When united with palladium.....	0·8540 to 0·8720
When united with palladium and platinum	0·7401 to 0·7545
When united with palladium and gold....	0·7110 to 0·7150
When united with palladium and silver...	0·7270 to 0·7420

The results, it will be observed, are most uniform with the compound alloys, in which retraction is avoided, and they lie between 0·711 and 0·7545. It may be argued that hydrogenium is likely to be condensed somewhat in combination, and that consequently the smallest number (0·711) is likely to be the nearest to the truth. But the mean of the two extreme numbers will probably be admitted as a more legitimate deduction from the experiments on the compounds alloys, and 0·733 be accepted provisionally as the approximate density of hydrogenium.

I have the pleasure to repeat my acknowledgments to Mr. W. C. Roberts for his valuable assistance in this inquiry.

* H = 1; Pd = 106·5.

ON CRYSTALS INCLOSED IN BLOWPIPE BEADS.

BY H. C. SORBY, F.R.S., ETC.

At the *soirée* of the Royal Society on March 6, by the kind assistance of my friend Mr. Wm. Baker, I exhibited a number of blowpipe beads inclosing various crystals of such extreme beauty as mere microscopical

objects, that probably some account of them may be interesting, independently of their connection with chemistry and mineralogy.

It has long been known that blowpipe beads often become opaque on flaming; and Emerson* showed that, by proper manipulation, well-formed crystals can be produced in them, and recognised by their characteristic forms when magnified. Rose† described very interesting results thus obtained in the case of titanic acid; and Captain Ross has published several papers in the Chemical News,‡ in which he gives the results obtained by blowing out the beads into thin vesicles, exhibiting minute characteristic crystals. My method differs materially from those described by the above-named authors. I use borax as the solvent, and, if requisite, add various reagents to produce, as it were, precipitates of characteristic crystalline form. By keeping the supersaturated fused beads over the flame, crystals may be obtained in cases where, according to Emerson, nothing satisfactory results from mere flaming; and the addition of various reagents adds greatly to our resources in the cases of earths variously mixed or combined with mineral acids. It is not my intention to enter now into the purely chemical part of the subject, or to show its application to mineralogy. I shall merely give a short account of some specimens thus prepared, which may be of interest as microscopical objects of remarkable character. Many are good illustrations of the manner in which crystals grow up from the simple nuclei to complicated forms of extreme beauty; and it is very instructive to see how the definite secondary planes of the crystals, viewed as a whole, are produced by the regularly graduated growth of numerous small crystals symmetrically deposited. This is sometimes so striking as to lead me to hope that further study may throw important light on the cause of the production of secondary crystalline forms.

In preparing the specimens, so much of the substance must be added to the borax that it entirely dissolves at a high temperature, but is partially deposited when kept for some time at a heat below dull redness. The beads should be about $\frac{1}{4}$ inch in diameter, and one-third that thickness. The loop in the platinum wire can easily be made circular by bending it round a glass rod. I need scarcely say that no one ought to expect to obtain good specimens at first. Much depends on that sort of manipulation which is easier to learn by experience than explain by writing.

The most useful object-glass is a 4-10 inch, of small aperture, made to adjust for looking through thick glass, so that crystals may be distinctly seen in the interior of the beads. When no condenser is used, the double convex form of the beads prevents our seeing more than a small portion of the interior; but by using as a condenser a plano-convex lens, of about $\frac{1}{2}$ inch diameter and $\frac{1}{2}$ inch focal length, nearly the whole bead is illuminated, without the definition being materially injured; and even this may be overcome by properly regulating the distance of the condenser, and the size of the aperture below it. The full beauty of the specimens can only be seen with a binocular microscope, and few objects are better fitted to show the advantage of that kind of instrument. The crystals then stand out in perfect relief, and are seen to be equally complicated in all directions. It must not be thought that in each case all the crystals are alike. Those formed on the surface differ much from those in the interior of the beads; and in both positions, though the type is constant, the forms vary very considerably.

After having obtained crystals of satisfactory character, if it be desirable to keep the specimen as a permanent object, the ring-shaped loop and inclosed bead should be cut off and mounted in a cell with Canada balsam. This is requisite, since the moisture of the atmosphere causes the borax to become hydrated and opaque; but, when properly mounted in balsam, it alters so slowly that I have not remarked any change for half a year. When thus mounted, the curved form of the beads almost ceases to be any impediment in examining crystals in the interior, and an ordinary achromatic condenser of long focal length may be used with advantage; but in some cases crystals on the surface are much less distinct than when the beads are not mounted.

Few objects of the kind are more easily prepared than the crystals of borate of magnesia deposited from borax saturated with magnesia. They first form as thin prisms, and smaller crystals are afterwards deposited, so as to give rise to objects very much like a handle with a brush at each end.

Zircon or zirconia fused with borax yields crystals of the borate. In their most rudimentary state they are small prisms with a simple cross at each end, which afterwards becomes complicated.

The crystals of molybdate of zirconia formed by fusing zirconia in borax with molybdic acid, are extremely elegant and beautiful objects. They are so delicate that their own weight would probably break them, if they were in an aqueous solution; but being supported in solid borax, like the insects inclosed in amber, they are secure from all injury.

Scheelite—native tungstate of lime—fused in borax is deposited in crystals of great beauty, and is an object easily prepared.

The molybdate of strontia, produced by fusing strontia and molybdic acid in borax, crystallises in long spindle-shaped crystals, whereas the molybdate of lime yields very different crystals, of a form intermediate between that of molybdate of zirconia and scheelite.

Apatite—native phosphate of lime—fused with borax, deposits in crystals which vary much in shape. Six-sided stars are often formed on the surface, and needle-shaped crystals grow from their centres into the interior of the borax, so that they look like nails with highly ornamental heads driven down into the bead. When formed with their axes parallel to the surface, the crystals are sometimes much like *diatomaceæ*. The addition of phosphate of soda to a borax bead containing lime in almost any state of combination gives rise to similar crystals.

On adding a certain amount of carbonate of soda to quartz or various silicates dissolved in borax, crystals are deposited, which vary much according to circumstances; but they all seem to be due to the variable growth of many small six-sided prisms with expanded ends. Sometimes they have a curious dice-box form, resulting from a bundle of such crystals. Probably such are some silicate of soda, modified by the presence of other bases.

Titanic acid gives hair-like prisms variously grouped. Molybdic acid is sometimes set free as liquid globules, which coalesce, rise to the surface, and afterwards solidify as small spheres.

* *Proceedings of the American Academy*, 1866, vol. vi., p. 476.
† *Berlin Acad. Bericht*, 1867, pp. 129, 450.
‡ Vol. xvi., p. 307 (*Am. Repr.*, *Feb.* 1868, *page* 74); vol. xvii. pp. 35, 63, 82, 87, and 107 (*Am. Repr.*, *March*, 1868, *page* 147; *April*, 1868, *pages* 157, 198, 196).

These few examples will, at all events, serve to show that the crystals deposited in blowpipe beads are of considerable interest, merely as beautiful microscopical objects. I should, however, be very sorry if any one were to imagine that I considered this their chief merit. On another occasion my aim will be to prove that this method may be employed with great advantage in determining the nature of minerals and chemical precipitates, when so small a quantity can be procured that other methods would almost or entirely fail to give satisfactory results.—*Monthly Microscopical Journal.*

ANALYSIS OF THE WATER.

OF THE

"ROYAL SULPHUR SPRING," HARROGATE.

BY SHERIDAN MUSPRATT, M.D. (HON.), F.R.S.ED., M.R.I.A., ETC.

The water of this new spring has recently been introduced into the Royal Pump Room at Harrogate Wells, and, as it may prove an efficient *intermediate* one (*i.e.*, not so *strong* as the "Old Sulphur Well," *vide* my analyses, Chemical News, vol. viii., p. 155 (*Eng. ed.*), and *stronger* than the "Magnesia Water," vol. viii., p. 195 (*Eng. ed.*), I forward the results for publication in your valuable journal. Its characteristics, on reaching me (it was in a large stone jar, well sealed), were the annexed:—

An opaque appearance, owing to a separation of sulphur; a strong smell (this it does not evolve when drawn from the pump) of sulphide of hydrogen, which, collaterally with the milky shade of the liquid, indicated oxidation and decomposition of the sodic sulphide (NaS). On immediately filtering the water, the filtrate was perfectly clear and bright. During the analysis, &c., I found that, on boiling the water by direct heat, and likewise by the agency of steam, 1·986 grains per gallon of the sulphur were eliminated as gas (sulphide of hydrogen), the remaining portion withstanding the effects of both kinds of caloric. The water was alkaline, due to the earthy carbonates. The sulphur calculated as gas (sulphide of hydrogen) constituted 11·80 cubic inches per gallon. By prolonged exposure to atmospheric influences, the *whole* of the sulphur in the water deposited. It gave no organic matter, and only mere indications of ammonia, &c. The occurrence of the salts of barium, strontium, lithium in all the spas of Harrogate is very remarkable, for these compounds did not, and could not, exist in them twelve years ago, when my distinguished collaborateur, Dr. Hofmann, investigated them. Sulphates have disappeared from all of them. I do not consider that the presence of the chlorides of barium and strontium in any way enhances their medicinal properties; for, as soon as the water is imbibed, the chlorides become sulphates.

There can be no question, I think, that the additional ingredients are derived from the strata in the vicinity of Pately Bridge, nine miles west of Harrogate. All the strong spas contain barium and strontium; the Dr. Muspratt Chalybeate "chloride of iron" (FeCl) also. A recent analysis of it gives 16 grains of this latter salt in the gallon; so the amount is just the same as it was when I discovered its presence in 1865. The efficacy of this ferruginous compound in a potable water is now beyond a doubt; it is more easily assimilated than any other ferrous salt: Dr. Myrtle remarks—"I could fill volumes with cases benefited or cured by its use."

College of Chemistry, Liverpool,
July 1st, 1869.

ON THE

EXAMINATION OF WATER FOR ORGANIC MATTER.*

BY R. ANGUS SMITH, PH.D., F.R.S., ETC.

(Continued from Am. Repr., August, 1869, page 80).

Use of Permanganate of Potash, or Chameleon.

It must be remembered that the amount of organic matter obtained in the above way by weighing and burning may be equal to several grains in a gallon, and yet be quite innocent; for example, it may be a little peaty matter. One method of trying the quality is given above; another, of a very convenient kind, is by the use of permanganate of potash, or mineral chameleon. It will here be called chameleon, as the former term is very long. It is very highly coloured, and its decomposition is known by the disappearance of the colour.

Chameleon is decomposed by putrid organic matter, and by several unwholesome gases, rapidly or instantaneously. It is decomposed by fresh organic matter, and especially organised matter, less rapidly. The putrid portion may be estimated readily; the latter is more uncertain.

In using this test, it is well to take not less than 5000 grains of the water, or, still better, 1000 grammes, *i.e.*, one litre; but if a small specimen only can be obtained, then as little as 1000 grains may be used; but it is well always to give the figures for 1000 for uniformity, or (by multiplying by 70) to change them into the amount per gallon; one million, however, is still better, and I propose to use it always for air and water. Grains or grammes may be used indifferently, the solution being made to contain simply so much in 1,000,000.

A convenient plan is to use 2 grains of the pure crystallised chameleon to 1000 of water. This, of course, is the same as 2 grammes to a litre of water.

The chameleon is poured conveniently from a Mohr's burette, or, better still, when the water is very pure, from a dropping-tube in which 1 c.c. is 6 to 8 inches long. Add a drop of the chameleon, and wait till the colour disappears; add another, and so on, till the colour remains permanent. The organic matter which decomposes the chameleon in a minute or two must be noted carefully; but generally there is a greater quantity which decomposes very slowly; the result obtained from the latter is, I believe, of less value. By decomposing in a minute or two, it is meant that when a few drops are added, producing a slight colour, this undergoes a change in a minute or two. But generally, considerable permanency is obtained in ten or fifteen minutes; then the slow decomposition begins of quite another quality of organic matter, requiring hours, or even days. This matter must be estimated either by the weighing process described, or by the further action of the chameleon, to be described. The amount decomposed instantly is a true measure of the putridity, it is believed. If there is very much organic matter, it

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester.* (Communicated with emendations and alterations by the author.)

is often very difficult to know when to stop, as the brown masks the red colour. But this must not bring discouragement, as experience will teach exactness; and, if it does not allow exactness, it then will be no great loss in such cases in a sanitary point of view, as in them there is decidedly too much organic matter, and the water may be condemned. From the same point of view, it is of less consequence whether the amount be a minute quantity more or less. It is well to make broad lines of distinction, and to condemn freely when there is rational hope of obtaining a purer water.

The amount of available oxygen in one of the solutions of chameleon described is 0·0005, which may be either grammes or grains, or almost exactly 1 of oxygen in 2000 of the solution. If we wish to know the amount of oxygen used, we simply divide the amount of chameleon by 2000. It is probable that the use of the oxygen column is the only exact method of recording the results; and it is probable that the amount of oxygen required is the only exact measure of the impurity of the substances. We obtain in this number the amount of oxygen which is required for purification.

Whilst looking over this plan in manuscript, I received Dr. Miller's paper, proposing also to use oxygen; he prefers a solution of chameleon containing 3·95 grains, equal to 1 grain of available oxygen to 10,000 of water, or 1 c.c.=0·001 gramme, or, say, 1 milligramme of oxygen. This is a very convenient method; but it has been thought proper to keep the tables as given for various reasons, chiefly arising from this—that it has not been found so convenient to keep or to titre a very weak solution. In some cases, a very strong solution is required; we can easily dilute it, but we cannot concentrate it readily. After estimating its strength, we dilute it (if we require a weak solution) to any amount we think proper; and as the strength changes, the amount of water to be added will also change. If the amount of oxygen is given as the result of the analysis instead of the amount of chameleon solution, the strength of the latter does not require to be kept uniform. The analyst requires only to know its strength at the time of using it. For very bad water, the strong solution may be used; and, when greater delicacy is wanted, it may be diluted. The weak solution here used is made by adding nine of water to one of the strong solution.

To make the chameleon solution, very pure water must be employed, and very pure crystals, as well as very pure vessels; it is better kept in considerable quantities, such as a quart or two. It must be tried occasionally, say every month, in a cool climate: calculation must be made as allowance for any change which it may undergo. If calculation is not agreeable, a less quantity of solution may be made at a time, and that which is over may be thrown away, a fresh amount being made to the normal strength whenever the original weakens; or a certain amount of the crystals may be weighed and added to the solution; but this has been found less convenient.

The estimation of the value of the chameleon is sometimes made with a solution of chloride of iron, sometimes oxalic acid. For ready reference, a table is made showing the amount of a solution of iron which corresponds to a certain amount of chameleon. The sulphate of ammonia and iron has proved to be very valuable. The writer has not found oxalic acid equally sharp and quick; but eminent chemists use it—Mohr and Miller, for example.

Values of the Strong Solution.

Permanganate of Potash or Chameleon 2 grammes in 1000 c.c. c.c.	Oxygen. gr.	Ferrum. gr.	$FeO,SO_3+NH_4O,SO_3+6Aq.$ gr.	KO,Mn_2O_7. gr.
1	0·000500	0·0035	0·0247	0·002
2	0·001000	0·0070	0·0494	0·004
3	0·001500	0·0106	0·0742	0·006
4	0·002000	0·0141	0·0989	0·008
5	0·002500	0·0176	0·1237	0·010
6	0·003000	0·0212	0·1484	0·012
7	0·003500	0·0247	0·1732	0·014
8	0·004000	0·0282	0·1979	0·016
9	0·004503	0·0318	0·2227	0·018
10	0·005000	0·03535	0·2474	0·020
100	0·050600	0·3535	2·4747	0·200
1000	0·506300	3·5353	24·7470	2·000

The numbers in the above table run in the following proportions nearly :—

Chameleon Solution.	Oxygen.	Iron.	Sulphate of Iron and Ammonia.	KO,Mn_2O_7 Crystals.
2000	1	7	49	4

It is convenient to use six figures of decimals, as they may also be read as whole numbers, meaning so much in a million.

Values of the Weak Solution.

Permanganate of Potash or Chameleon Solution. 0·2 gramme in 1000 c.c. c.c.	Oxygen. gr.	Ferrum. gr.	$FeO,SO_3+NH_4O,SO_3+6Aq.$ gr.	KO,Mn_2O_7. gr.
1	0·000050	0·00035	0·00247	0·0002
2	0·000100	0·00070	0·00494	0·0004
3	0·000150	0·00106	0·00742	0·0006
4	0·000200	0·00141	0·00989	0·0008
5	0·000250	0·00176	0·01237	0·0010
6	0·000300	0·00212	0·01484	0·0012
7	0·000350	0·00247	0·01732	0·0014
8	0·000400	0·00282	0·01979	0·0016
9	0·000450	0·00318	0·02227	0·0018
10	0·000500	0·003535	0·02474	0·0020
100	0·005060	0·03535	0·24747	0·0200
1000	0·050630	0·35353	2·47470	0·2000

In the oxygen column, 6 and 3 may be left out.

The first and under might be called the first quality of water; from 0·1 to 0·2, the second; 1 would be the tenth.

When it is considered better to acidify the water before adding the permanganate, this is done by adding 3 drops or water-grain measures of sulphuric acid to 1000 grains; some water will demand more; the object is to attain acidity equal to about 3 drops of sulphuric acid in 1000 grains of distilled water. I find Dr. Miller says 50 grains of diluted sulphuric acid (1 of acid to 3 of water) added to 8 ounces of water. Acid enables the oxygen to act on more matter, and more rapidly. Alkalies prevent the action, although they may prepare some of the matter to be more readily oxidised: when the colour has been difficult to see, the chameleon may have been used with alkali instead of acid, in which case a green colour is obtained, serving usefully as a corroboration.

As an illustration of the mode of examining water so as to obtain the first and the second conditions, if we may so call them, of organic matter, I will quote here a short paper, read to the Philosophical Society of Glasgow, on the water of the river Clyde. I think I there gave the proper use of the permanganate of pot-

ash.* There is a very sharp separation between those substances that decompose the permanganate at once and without acid and those which do so on the addition of acid, and after a short time. So decided is this, that I consider them as indicating two different conditions of organic matter.

"I thought it would be interesting to test the Clyde in this way, and for that purpose obtained specimens at various points from near Bothwell to the sea, afterwards continuing till the vessel came near Liverpool.

"The column to observe is number 1 of annexed table of either series. This gives the amount of oxygen consumed instantly, and corresponds, as I believe, to the amount of decomposed matter which has left in solution putrid gases, whatever these gases may be. We may suppose them to be sulphuretted hydrogen in minute quantities, or compounds of sulphur, or organic substances only, or all mixed. In the part of the Clyde near Glasgow, all these compounds will probably be found; as we go near the Firth, the sulphur will be fully oxidised, and the organic compounds only will be the active agents in taking up the oxygen, as they oxidise more slowly.

"The amount of oxygen is calculated from the amount of permanganate employed. The method is an extension of the original idea given out by the late Forchhammer many years ago; the amount of water used was 100 c.c., or 1544 grains. The permanganate required to give perfectly pure water perceptible colour was in every case subtracted from the number obtained.

"The examination of the Clyde is not perfect, but there is much to be seen that is interesting. Specimens ought to have been taken higher than any town on the river.

"The first was taken about 6½ miles above the quay at Glasgow. We there find the oxygen required for the water to be 0·000045 per cent by weight, or equal to 3·15 grains per 100 gallons. When we come to the Broomielaw, at Glasgow, we find the amount of oxygen demanded had risen to 0·000022 per cent by weight, or 15·40 grains per 100 gallons.

"We then see it steadily diminishing; and when we arrive at Port Glasgow, 20 miles down, it has become equal to that at 6½ miles above Glasgow. If we had taken the north side, below Dumbarton, instead of the south, on which the vessels sail, the difference would have been greater.

"Leaving Greenock, and turning the point, we have a rapid change; and when off the west of Gourock Bay, at the distance kept by the Liverpool vessels, the amount of oxygen demanded fell to 1·05. Off Wemyss Bay, the fall is remarkably low; but it is not always so, as it depends on tide and wind. The current seems to run down the centre, whilst the ocean water comes up the coast. The winds and floods may modify this.

"We have to observe a complete change about Gourock or the Cloch, if we keep to the south and east side; but, if we keep to the north, the greatest change is perceptible not far off Helensburgh.

"This wide space of water reduces the amount of oxygen required to 0·00001 per cent by weight, or 0·7 grain per 100 gallons.

"We are now led to ask if the purest state of the water is attained here. We may go further towards the open sea, and find that the amount required falls to 0·000005 per cent by weight, or 0·35 grain per 100 gallons. This is at Arran, where the sea is more extensive, and oxidation, even of the peaty matter from the hills, is nearly completed. We observe this to continue till the entrance of the North Atlantic is past; and, as we come south, to a narrower channel, the amount of oxidisable matter increases, and keeps up steadily till we arrive at Liverpool. No specimen was taken nearer than 17 miles from Liverpool. The point 0·00001 per cent oxygen by weight, or 0·7 grain per 100 gallons, is an important one to examine. We find that at Dunoon, Innellan, and Holy Loch, this amount may be called permanent. We may ask, Why does it not fall lower? and is it true that the sewage of Glasgow affects the Firth until we arrive at Lamlash, and obtain the number 0·000005 per cent oxygen by weight, or 0·35 grain per 100 gallons?

"We observe that the amount of purification is remarkably rapid whenever the Clyde widens, as at Greenock to Gourock; so that, even near Helensburgh, the number has fallen to 0·0000125 per cent oxygen by weight, or 0·875 grain per 100 gallons. This change, from 0·000045 or 3·15 grains per gallon has been effected in the space of about 2 or 3 miles. Is it possible, then, that the slight further change required demands all the wide distance between Gourock and Arran? I think not. The reason we do not find the number for oxygen falling below 0·00001 per cent by weight, or 0·7 grain per 100 gallons, at Holy Loch, Strone, Dunoon, and Cove, may be seen by examining the Lochs. We there find that they themselves send in water with the oxygen number 0·00001 per cent by weight, or 0·7 grain per 100 gallons.

"At this point we must remember that the oxygen may not all be required for putrid matter, and that the streams contain some peaty matter which may also instantly require oxygen. At any rate, we know this, that, for whatever they do require it, it can be for the destruction of no very unwholesome matter in the water, as the highland streams must be considered free from such taints. There is a little of the soil of cattle, when the weather is wet, but perhaps none when the weather is so dry that the water must pass through the earth before reaching the bed of the stream.

"We cannot, then, expect the sea-water to demand less oxygen than the streams and lochs that affect it here. In other words, we discover the influence of the land on the drainage from the hills, even when all trace of the influence of Glasgow has gone. This is, I believe, the reason that, according to circumstances, such as currents and weather, we observe the water of the Firth sometimes as pure as the deep sea, and at other times less so. At Wemyss Bay, for example, the table does not show this very well. This will happen at other parts of the coast when the streams enter purer than the usual sea-water there, as, for example, at Dunoon and Innellan, where the water flows from streams equal, when not in flood, to the deep Firth water. We see the influence of the coast, also, as we go on towards Liverpool, and between the Isle of Man and Lancashire.

"I considered that 0·00001 per cent oxygen by weight, or 0·7 grain per 100 gallons, marked the limits of the Glasgow sewage. If the sewage were not all ex-

* We never understood the author of this paper to claim having first used permanganate of potash for water. He readily acknowledges being later than Dr. Miller and Dr. Woods, and still later than Mr. Condy, who seems first to have carried out Forchhammer's idea. He simply wishes to show his mode of analysis and the results, leaving the question of merit entirely aside.—*Ed. C. N.*

pended, the amount would be greater, because the lochs and their streams do not show a higher number. Whenever the water of the Firth falls down to that of the streams, we are, as I suppose, receiving the air at least as pure as the air above the streams on the hills, and may be contented.

"Some people will perhaps demand more than this number. I have not made examinations far enough towards the ocean to enable me to speak of it; but it seems to me that the numbers 0·00001 per cent by weight, or 0·7 grain per 100 gallons, of the streams, and 0·00005 or 0·35 grain per 100 gallons, mark two very important points. The first characterises air which is certainly most wholesome and agreeable; the second is that ocean air which some persons require, but which to others is said to be too strong. On the meaning of this expression "too strong," I will not attempt to speak; but it is very much used by a great public, and it must have a wide foundation. It is apparently certain that to some it is important not to have the extremely strong or perhaps purest air.

"These observations seem most curiously to coincide with general observation. The current of the Clyde keeps to the south; and we see that the water changes less rapidly there. At the north the direct current is not much observed, and the influence of the lochs or fiords is seen. The water from them presses against the Clyde current, and aids in keeping it to the south-east. This has influenced the building of the numerous residences on the Argyle side, lining all the coast. The population has not found it needful to make a chemical analysis, but has seen where the purest water was with the unaided eye. A mode of observation, apparently quite as good as chemical analysis, is the examination of the rocks on the coast, the dark and dirty aspects of those in impure water being very striking.

"I am not, however, inclined to look on my work here as useless, although common observation has done its part so well. I believe it to be of great importance to us to be able to apply tests so as to prove the truth of popular belief, which is formed by long and tedious processes. With these little chemical experiments we may do the work in an hour, which the instincts and expensive experience of whole generations were required to perform.

"I believe that in these results we have a method of examining the coasts which will be valuable to us as a sanitary police. It can be applied wherever there are sheets of water.

"I will not say that these numbers represent the relative wholesomeness of places on the land and on the sea; but I think it probable that they may fairly be used as comparisons of places on the sea only. When the land is in question, there are many sources of emanations to be considered.

"To be complete, the examination ought to be continued for several years. Last year was not an average one; there was much rain. (This regarding the Clyde and the sea was read in Dec. 1866.)

"There are floods in the Clyde which bear down so much water that the brown peaty matter is readily seen below Dunoon; but on these occasions there is no fear of putrid matter, as the water carried down is so abundant. At the same time there will be a certain degree of purity less at the sea-entrance, corresponding to the greater degree of purity caused by the flood at Glasgow. By this it is not meant that the water as low as Cloch or Dunoon is affected by more than an infinitesimally small amount of the sewage matter which is washed past Glasgow in floods, whilst at other times the effect has ceased, as before said, at least on the north, below Helensburgh. There is, however, a little muddiness observable for many miles, and this will be found even in places where the oxidation of all the readily transported matter has taken place.

"Even where total oxidation has occurred, a little muddy matter remains. It consists chiefly of earthy bodies, which may float until they obtain a suitable place for deposit.

"It would be interesting to find the time needful to perform this change on the organic matter of Glasgow. We see that the great bulk of the purification is performed in the fresh water. At Dumbarton it must be rare indeed that anything can be known to exist in the water from its smell. When the Clyde passes into the estuary, which may be said to begin at the Rock of Dumbarton, the change is effected by spreading the water over many square miles, and preparing it effectually for those who enter the sea- and loch-regions below Helensburgh. Below this point it is not a river on which we are, but an arm of the sea, protected on all sides from oceanic waves.

"The water bears the qualities of coast-water in proportion to its excessive length of coast. This quality must exist more or less on all coasts which have fresh springs running into them. In cases where the rivers are large or numerous, the evil of the meeting of fresh and salt water is well known. On the Firth of Clyde no large bodies of fresh water are found after we leave the mouth of the river portion of the Clyde; and, as observed, these streams are remarkably pure, or, if coloured, it is only by peat-water. The absence of great rivers is therefore an advantage of an important kind to this coast.

"I was extremely glad to be able to speak thus favourably of the districts which are so agreeable to me; but I am certainly desirous of speaking still more favourably of some which are too much affected by Glasgow. They may be constantly deteriorating. This is a very serious matter, not merely for owners of property on the Firth, but for all the inhabitants of Glasgow, who are favoured more than those of any other large city in the kingdom by a ready access to this wonderful sanitorium.

"In making these remarks, I take it for granted that the air above the water will be pure in inverse proportion to the amount of volatile oxidisable matter.

"We must not, however, forget that, if the river is rendered impure, the town is proportionately purified. And we must also remember that the work done in the water is enormous. If the refuse matter were allowed to evaporate into the air, and so collect its oxygen, the act of purification would go on in the air we breathe; but now the water draws in oxygen, and, as soon as it is consumed, it draws in more. Even the air over the river is, at a distance of a few miles down, purer than the air of many towns; and when the spaces widen, the case is stronger still.

"I have sometimes inquired if we obtained in fish an equivalent of the manure sent out, and if it is not easier to gather the crop in boats than to put the manure laboriously on land. I find, however, that the loss by putrefaction, oxidation, and evaporation is so rapid that there was no hope of it being used profitably. In one current examined, a very deep one, and much stronger in sewer matter than the Clyde

ever is, the whole nitrogen had disappeared in three days, the greater part in much less.

"Whilst the chief object of my paper is to show a new mode of examining climate as well as streams, I am glad to be able to say that Glasgow has failed to destroy the purity of the Firth beyond the points indicated, and that we may still rejoice in our summer dwellings. It is, however, not to be forgotten that the effects are found too far away, and that twenty-two miles of mischief is more than abundance. It is to be hoped that the cautious policy of the City in waiting for the best method to be adopted for using its refuse will enable it to carry out that future work, whatever it may be, with the greatest success.

"I have referred only to the 1st column: it indicates the amount of permanganate decomposed instantly; this represents the gases of decomposition, such as most readily pass into the atmosphere.

"It will not be supposed that this is the only offensive matter.

"The 2nd column represents the amount when acid is used to assist the oxidation. I suppose this to represent the amount easily decomposed.

"The 3rd column of the original paper, left out here, represents the amount of oxygen used by the organic matter in twenty-four hours. I do not at present see its use. I do not think this at all a fair mode of representing the impurity of water, unless we are sure that the quality does not change. We see this by the numbers above, and at Glasgow Bridge. The purer water has, by this mode of representing it, the appearance of being equal to the worst. The only column that gives the continuous increase and decrease exactly as the senses find the case to be, is the column No. 1.

Time.	Oxygen per 100 gallons required to oxidise		Oxygen by weight required to oxidise 1,000,000	
	I. The decomposed organic matter.	II. The easily decomposable organic matter.	I. The decomposed organic matter.	II. The easily decomposable organic matter.
Aug. 15, '66.				
6½ miles above Glasgow 3.30 p.m.	3·15	11·55	45·0	165·0
5½ miles above Glasgow 3.15 "	4·55	9·45	65·0	135·0
5 miles above Glasgow, Cambuslang 3 "	5·95	11·20	85·0	160·0
Broomielaw 1.30 "	15·40	22·05	220·0	315·0
Mouth of Kelvin 1.20 "	11·55	18·20	165·0	260·0
100 yds. below Renfrew 1 "	10·85	25·55	155·0	365·0
100 yds. above Bowling 12.45 "	4·55	8·05	65·0	115·0
At Dumbarton 12.30 "	4·55	6·65	65·0	95·0
Between Greenock and Port Glasgow 12.10 a.m.	3·15	4·20	45·0	60·0
July 25, '66.				
Gourock 12.55 p.m.	1·05	1·75	15·0	25·0
Cloch 12.45 "	1·05	1·57	15·0	22·5
Inverkip 12.30 "	0·70	1·40	10·0	20·0
Wemyss Bay 12.15 "	0·35	0·87	5·0	12·5
Opp. Toward 12 noon.	0·70	1·05	10·0	15·0
Between Toward and Cumbrae 11.30 a.m.	0·70	1·05	10·0	15·0
Opp. Cumbrae Lighth. 11 "	0·70	0·87	10·0	12·5
Opp. Lamlash 10.15 "	0·35	0·70	5·0	10·0
July 25, '66.				
188 10 a.m.	0·35	0·87	5·0	12·5
176. Ailsa Craig 9 "	0·35	0·73	5·0	10·0
160. From Liverpool 8 "	0·35	0·87	7·5	12·5
131. From Liverpool 6 a.m.	0·52	0·87	7·5	12·5
103. " " 4 "	0·52	0·87	10·0	12·5
74. N. of Isle of Man 2 "	0·70	1·05	12·5	15·0
July 24, '66.				
46. From Liverpool 12 night.	0·87	1·22	12·5	17·5
32. " " 11 p.m.	0·87	1·40	12·5	20·0
17. " " 10 "	1·05	1·75	15·0	25·0
Aug. 13, '66.				
Off Greenock 5·10 p.m.	1·40	1·57	20·0	22·5
Aug. 15, '66.				
Off Helensburgh 6·35 p.m.	0·875	1·22	12·5	17·5
Aug. 13, '66.				
Off Gourock 5 p.m.	1·22	1·57	17·5	22·5
Aug. 13, '66.				
Between Kirn and Gourock 6 p.m.	1·22	1·40	17·5	20·0
July 30, '66.				
Arrowchar (Loch Long) 1·30 p.m.	0·70	1·05	10·0	15·0
Aug. 15, '66.				
Off Mouth of Loch Long 6·55 p.m.	0·875	1·40	12·5	20·0
Aug. 17, '66.				
Head of Loch Goil 1.5 p.m.	0·875	1·05	12·5	15·0
Entrance of Loch Goil 4.30 "	1·05	1·22	15·0	17·5
Aug. 1, '66.				
Head of Holy Loch 2·45 p.m.	0·70	1·57	10·0	22·5
Middle of Holy Loch 2·30 "	0·52	1·05	7·5	15·0
July 31, '66.				
Dunoon (several 100 yds. from shore) 1 p.m.	0·70	1·22	10·0	17·5
Dunoon (about 800 yds. from shore) 1.15 "	0·70	1·22	10·0	17·5
Aug. 16, '66.				
Off Dunoon 1 p.m.	0·70	0·875	10·0	12·5
Aug. 20, '66.				
Stream at West Bay, Dunoon 1 p.m.	0·52	0·70	7·5	10·0
Stream between Innellan and Dunoon 12 noon.	0·35	0·52	5·0	7·5
Aug. 16, '66.				
Between Innellan and Dunoon 1·8 p.m.	0·875	1·05	12·5	15·0
Off Innellan 1·15 "	0·70	0·875	10·0	12·5
Aug. 9, '66.				
Off Wemyss Bay (high tide) 12 noon.	1·05	1·22	15·0	17·5
Off Wemyss Bay (low tide) 4.30 p.m.	0·875	1·22	12·5	17·5

"It is not, however, meant that the gases of decomposition are the only evils to be apprehended from impure water; but, so far as I know, they are those that affect the air principally (from this source). The most dangerous bodies are probably in the water itself, and it is possible that they may not be affected by the process of column 1.

"I am not inclined to draw any important conclusion from the total organic matter without inquiring into its character. At present, I believe, we are quite safe in attending to the conclusions here given in column 1, with such precautions as I have elsewhere indicated —when, for example, nitrites, sulphites, &c., are present. By and by we shall learn the true mode of dealing with the other columns."

(To be continued.)

RESEARCHES ON VANADIUM.*

BY HENRY E. ROSCOE, B.A., PH.D., F.R.S.

Part II.

On the Chlorides of Vanadium and Metallic Vanadium.

In the first part of these researches ("Bakerian Lecture," *Phil. Trans.*, 1868, pt. i.) the author stated that the chlorides of vanadium, and probably also the metal itself, could be prepared from the mononitride, the only compound of vanadium not containing oxygen then known. The process for obtaining the mononitride described in the last communication was that adopted by Berzelius for preparing the substance which he conceived to be metal, but which, in reality, is mononitride. This method consists in the action of ammonia on the oxitic chloride; but it cannot be employed for the preparation of large quantities of nitride, owing to the violence of the action and consequent loss of material. The author, seeking for a more economical method, found that if the ammonium metavanadate (NH_4VO_3) be heated for a sufficiently long time at a white heat in a current of dry ammonia, pure vanadium mononitride remains behind. Analysis of a sample thus prepared gave 79·6 per cent of vanadium and 20·2 per cent of nitrogen, theory requiring 78·6 and 21·4 per cent respectively. The mononitride may likewise be directly prepared by igniting vanadium trioxide (V_2O_3) in a current of ammonia at a white heat in a platinum tube, and also by subjecting the dichloride to the same treatment.

The Chlorides of Vanadium.—Three chlorides of vanadium have been prepared, viz.:—

Vanadium tetrachloride	VCl_4
Vanadium trichloride	VCl_3
Vanadium dichloride	VCl_2

1. *Vanadium Tetrachloride*, VCl_4, molec. wt.=193·3, V.D =96·9 (H=1).—This chloride is formed as a dark reddish brown volatile liquid, when metallic vanadium or the mononitride is burnt in excess of chlorine. The first method adopted for the preparation of this chloride was to pass dry chlorine over the mononitride heated to redness; the whole of the nitride volatilises and a reddish brown liquid comes over. In one operation 44 grains of the crude tetrachloride was thus prepared; the liquid is purified by distillation, first in a current of chlorine and then in a stream of carbonic acid gas. On fractionating, the liquid was found to boil at 154°C. (corrected) under 760 m.m. of mercury. The second method depends upon a fact already noticed in the preceding communication, that the oxytrichloride ($VOCl_3$), prepared, according to the directions of Berzelius, by passing dry chlorine over a mixture of the trioxide and charcoal, possesses a port-wine colour instead of the canary-yellow tint of the pure substance. This dark colour is due to the formation of the tetrachloride of vanadium, and if the vapours of the oxytrichloride, together with excess of dry chlorine, be passed several times over a column of red-hot charcoal the whole of the oxygen of the oxychloride can be removed, and at last perfectly pure tetrachloride, boiling constantly at 154°, is obtained. This reaction, it will be remembered, served first to demonstrate the existence of oxygen in the oxytrichloride. In each distillation of the tetrachloride a peach-blossom coloured solid residue remained in the bulbs; this substance is vanadium trichloride, and it slowly burns away in excess of chlorine when heated, forming tetrachloride.

The composition of the tetrachloride was established by six well-agreeing analyses, made from several different preparations. The mean result is:—

	Calculated.	Found.
$V = 51·3$	26·54	26·87
$Cl_4 = 142·0$	73·46	73·02
193·3	100·00	99·89

Owing to the facility with which the tetrachloride splits up into trichloride and chlorine, a solid residue was left in the vapor-density bulb, and the density of the vapour (at 219°) was found by Dumas's method to be 99·06 (or 6·86) instead of 96·6 (or 6·69). By volatilising the liquid in a small bulb, and allowing the vapours to pass into a large bulb already heated above the boiling-point of the liquid, this deposition of trichloride was avoided, and the density was found to be 96·6 or 6·69 at 205°, and 93·3 or 6·48 at 215°, the last determination indicating that a partial decomposition into VCl_3 and Cl had occurred. The specific gravity of the liquid tetrachloride at 0° is 1·8584; it does not solidify at −18°, nor does it at this or any higher temperature undergo change of properties on treatment with chloride. It not only undergoes decomposition on boiling, but at the ordinary atmospheric temperatures it splits up into VCl_3 and Cl. Tubes in which the liquid chloride had been sealed up have burst by the pressure of the evolved chlorine. Thrown into water, the tetrachloride is at once decomposed, yielding a blue solution identical in colour with the liquid obtained by the action of sulphurous or sulphydric acids on vanadic acid in solution, and containing a vanadous salt, derived from the tetroxide V_2O_4. In order to prove that a vanadous salt is formed when the tetrachloride is thrown into water, the solution thus obtained was oxidised to vanadic acid by a standard permanganate solution. The calculated percentage of oxygen thus needed, according to the formula

$$2VCl_4 + O + 4H_2O = V_2O_5 + 8HCl$$

is 4·14; the percentage of oxygen found by experiment was 4·11.

The solution of the tetrachloride in water does not bleach; but if the vapour be led into water a liquid is obtained which bleaches litmus. Vanadium tetrachloride acts violently on dry alcohol and ether, forming deep-coloured liquids. The author is engaged upon the examination of this reaction.

Bromine and vanadium tetrachloride, sealed up and heated together, do not combine; on the contrary, trichloride is deposited. Hence it is clear that vanadium does not readily form a pentad compound with the chlorous elements.

2. *Vanadium Trichloride*, $VCl_3 = 157·8$.—The trichloride is a solid body, crystallising in splendid peach-blossom coloured shining tables, closely resembling in appearance the crystals of chromium sesquichloride. It is non-volatile in hydrogen, and, when heated in the air, it decomposes, glowing with absorption of oxygen, and forming the pentoxide. Heated in hydrogen, the trichloride first loses one atom of chlorine, forming the dichloride (VCl_2), and afterwards, on exposure to a higher temperature, loses all its chlorine, leaving metallic vanadium as a grey lustrous powder. The trichloride is extremely hygroscopic, deliquescing on exposure to air to a brown liquid. The trichloride is best prepared by the quick decomposition of the tetrachloride

* Abstract of a paper read before the Royal Society, June 17, 1869.

at its boiling point, or by its slow decomposition at the ordinary temperature of the air. The crystalline powder obtained by either of these methods only requires freeing from adhering tetrachloride, by drying in carbon dioxide at 160°, in order to yield good analytical results.

	Calculated.	Mean of 4 analyses.
V = 51·3	32·5	32·57
Cl_3=106·5	67·5	67·42
157·8	100·0	99·99

The trichloride thrown into water does not at once dissolve; but, as soon as the crystals get moistened, a brown solution is formed, which becomes green on addition of a drop of hydrochloric acid, and contains a hypovanadic salt in solution. This green tint is identical with that got by reducing a solution of vanadic acid in presence of magnesium. According to the equation—

$$2VCl_3+O_2+3H_2O=V_2O_5+6HCl$$

the solution of the trichloride requires 10·14 per cent of oxygen to bring it up to vanadic acid, whilst analysis showed that 10·1 per cent was necessary. The specific gravity of the trichloride at 18° is 3·00.

3. *Vanadium Dichloride*, VCl_2=122·3.—The dichloride is a solid, crystallising in fine bright apple-green micacious plates. It is prepared by passing the vapour of vanadium tetrachloride mixed with hydrogen through a glass tube heated to dull redness. If the heat be pushed further, a blackish crystalline powder, consisting of a mixture of lower chloride and metal, is obtained. The dichloride, when strongly heated in hydrogen, loses all its chlorine, leaving vanadium in the metallic state in grey crystalline grains. Analysis gave:—

	Calculated.	Mean of 2 analyses.
VCl=51·3	41·95	42·16
Cl_2 =71·0	58·05	57·88
122·3	100·00	100·00

Vanadium dichloride is extremely hygroscopic; when thrown into water, a violet-coloured solution is formed, identical in tint with the liquid containing a hypovanadous salt obtained by reducing vanadic acid in solution in presence of zinc or sodium-amalgam; and like this latter liquid, the solution of dichloride in water bleaches strongly by reduction.

Oxidised by permanganate, this liquid required 18.78 per cent oxygen (on the dichloride taken) to bring it up to vanadic acid, whereas the equation—

$$3VCl_2+O_3+2H_2O=V_2O_5+4HCl$$

requires 19·6 per cent. The specific gravity of vanadium dichloride at 18° is 3·23.

Metallic Vanadium, V=51·3.—Although from what we know of the characters of vanadium, it appeared unlikely that any compound containing oxygen would yield the metal by direct reduction, the author has repeated the experiments of other chemists on this subject, but without success. There is no doubt that the metal cannot be obtained by any of the processes described in the books. The only methods which promised possible results were:—

1. The reduction of a vanadium chloride (free from oxygen) in hydrogen gas, either with or without sodium.
2. The reduction of the mononitride at a white heat in hydrogen.

The first of these methods has proved to be successful, whilst the second does not appear to yield metal, inasmuch as the nitride exposed for 3½ hours in a platinum tube to the action of hydrogen at a white heat, lost only 8 per cent, whereas it must lose 21·4 per cent on conversion into metal.

Notwithstanding the apparent simplicity of the method, the author has found it exceedingly difficult to obtain the metal perfectly free from oxygen. This arises from the fact that, whilst vanadium is quite stable at the ordinary temperature, it absorbs oxygen with the greatest avidity at a red heat, and that, therefore, every trace of air and moisture must be excluded during the reduction. Another difficulty consists in the preparation of the solid chlorides in large quantity and free from oxygen or moisture, as also in the length of time needed to reduce these chlorides in hydrogen, during which time unavoidable diffusion occurs, and traces of oxygen enter the tube. Again, the reduction can only be effected in platinum boats placed in a porcelain tube, as the metal acts violently on glass and porcelain, and tubes of platinum are porous at a red heat.

A description of the apparatus employed is then given, the main points being to guard against diffusion, and to introduce the powdered dichloride into the platinum boat in such a way that it shall not for an instant be exposed to moist air. After all precautions are taken, the tube is heated to redness, torrents of hydrochloric acid come off, and the evolution of this gas continues for from 40 to 80 hours, according to the quantity of dichloride taken. After every trace of hydrochloric acid has ceased to be perceptible, the tube is allowed to cool, and the boat is found to contain a light whitish grey-colored powder, perfectly free from chlorine.

Metallic vanadium thus prepared, examined under the microscope, reflects light powerfully, and is seen to consist of brilliant shining crystalline metallic mass, possessing a bright silver-white lustre. Vanadium does not oxidise or even tarnish in the air at the ordinary temperature; nor does it absorb oxygen when heated in the air to 100°. It does not decompose water even at 100°, and may be moistened with water, and dried *in vacuo*, or at 100°, without gaining weight. The metal is not fusible or volatile at a bright-red heat in hydrogen; the powdered metal thrown into a flame, burns with the most brilliant scintillations. Heated quickly in oxygen, it burns vividly, forming the pentoxide; but slowly ignited in air, it first glows to form a brown oxide (possibly V_2O), and then again absorbs oxygen, and glows with formation of the black trioxide and blue tetroxide, till it at last attains its maximum degree of oxidation. The specific gravity of metallic vanadium at 15° is 5·5. It is not soluble in either hot or cold hydrochloric acid; strong sulphuric acid dissolves it on heating, giving a yellow solution; hydrofluoric acid dissolves it slowly with evolution of hydrogen; nitric acid of all strengths act violently on the metal, evolving red nitrous fumes, and yielding a blue solution: fused with sodium hydroxide, the metal dissolves with evolution of hydrogen, a vanadate being formed.

One sample yielded on oxidation a percentage increase of 77·94, whereas that calculated from metal to pentoxide is 77·98. Another preparation gave a percentage increase of 70·8, showing the presence of a small quantity of oxide. On treatment in a current of chlorine, metallic vanadium burns and forms the reddish-black tetrachloride; heated in a current of pure nitrogen, the mononitride is formed.

The properties of the compounds of vanadium with silicon and platinum are then described in the memoir.

ON

COLOPHONINE AND COLOPHONIC HYDRATE,

NEW SUBSTANCES PROCURED FROM THE PRODUCTS OF THE DESTRUCTIVE DISTILLATION OF RESIN.*

BY CHARLES R. C. TICHBORNE, M.R.I.A., F.C.S., ETC.

When we submit to distillation (either with or without water) the natural exudations of the different pines, the first result is the extraction of volatile hydrocarbons, or oils of turpentine. These oils were, until very lately, considered as identical, but recent investigations have proved that there is a considerable disparity in the products from different species of the pines. If, after the extraction of the volatile oils, the distillation is pushed further, we get a second series of volatile compounds, which, however, differ materially from the first, inasmuch as they are decomposition products, resulting from the splitting up of the colophony, or resinous part, into more simple molecules of different isomeric modifications.

All the resin oils obtained by myself gave the result I am now about to detail. I, however, believe that the discrepancies exhibited by the turpentines are perpetuated through the products obtainable upon the destructive distillation of the resins proper to such turpentines.

My attention was first directed to the substance which I have named colophine from an observation made preparatory to investigating the volatile oils procured on submitting resin to destructive distillation.

I took commercial resin, and, after drying for some time at a slightly elevated temperature, distilled it in an iron retort. I got, by this means, a thick distillate, which contained a considerable quantity of undecomposed resin. Gaseous products escaped which are said to contain ethylene, tetrylene, and marsh gas. The liquid products amounted to about 74 per cent of the resin employed, and a small coke was left in the retort. This thick oil, on rectification, gave about 5 to 6 per cent of a light yellow but mobile fluid, which is known under the names of "resin spirit," "vive essence," "Harzessenz." †

This lighter portion, or "resin spirit," is supposed to consist mainly of the hydrocarbons homologous of the series $C_n H_{2n-4}$ and $C_n H_{2n-6}$, and an oxygenated oil, which has been named colophonone.‡ It is these light oils that yield colophonic hydrate. They act energetically upon the fluid alloy of potassium and sodium, even when free from the last-named substance; therefore it is probable that colophonone, or other oxygenated oils, form a large ingredient.

It is given as a specific characteristic of colophonone, that, if it is treated with sulphuric or hydrochloric acid, a green oil separates on the addition of water. This is, however, only partially true; for I found that the "resin spirit"§ procured in the above experiment, or old resin spirit that had been washed, only gave this reaction in a slight degree.

It was, therefore, evident that the colour-phenomenon was due to the presence of some other substance soluble in water, and not to a specific property of the colophonone. On treating old resin spirit with distilled water two or three times, and on evaporating these washings at a low temperature, a brown crystalline mass was procured, which gave the colour-reactions, hitherto attributed to the oil itself, in a most vivid manner. It therefore becomes evident that the whole subject of colophonone requires revision. It was probable that the substance analysed under that name was a mixture.

I subsequently obtained specimens of the new substance in which individual crystals had attained some considerable magnitude.

Some of them were 3 centimetres long, and over 2 grammes in weight. They were of an amber colour, from impurities, and were obtained by submitting a large volume (10 litres) of the spirit, in an imperfectly-closed vessel, to twelve months' slow evaporation and oxidation. I have procured as much as 281 grammes of the crude crystals from 4·5 litres of resin spirit by washing.

The following are the characteristics of this compound, which, when purified, is a truly beautiful substance:—

Colophonic hydrate is white, perfectly odourless, and has a sweetish taste; it is very soluble in water, alcohol, ether, chloroform, and tetrachloride of carbon; not quite so soluble in cold benzole and resin spirit, but slightly soluble in cold bisulphide of carbon.

Colophonic hydrate crystallises readily from water or alcohol, in beautiful acicular prisms, which sometimes attain some magnitude. Heated, it melts and sublimes, with a partial loss of the elements of water. The crystals which first sublime lose water, but nearly resemble those obtained from a solution, both as regards their appearance and composition. Those which afterwards rise (or if the first are re-sublimed) lose more water, and form hexagonal plates, or fern-like fronds, of great beauty. It was found impossible to accurately measure the large crystals already mentioned, the twelve months' immersion having rounded and worn the faces, from the rise and fall of temperature in the medium in which they are formed. They seem to belong to the dimetric system, and are the result of the combination of the two prisms of that system.

The hydrated crystals, when placed over sulphuric acid, or *in vacuo*, gradually lose water, and effloresce; but, as the substance is itself volatile, the loss could not be measured under such circumstances. When placed under a bell-glass over sulphuric acid, the surface of the acid becomes covered with a green film, produced, as will be afterwards explained, by the mutual action of the water, sulphuric acid, and colophonic hydrate. Some difficulty was experienced in procuring the anhydrous compound. From the above results, it was supposed that, on submitting the hydrate to sublimation, the water of hydration would be dissociated. Such, however, was not the case, and a combustion of the sublimed crystals pointed to no formula. The sublimate was, in fact, a mixture of the anhydrous and hydrated compounds.

The first of these substances I obtained in the following manner:—I gently fused, in a test-tube, for some time the crystals obtained from an aqueous solution, occasionally drying out the moisture which condensed at the top of the tube with bibulous paper. The sublimed crystals were repeatedly broken down, and mixed with the fused mass. This process was continued as long as moisture was given off. I retained the crystal-

* Communicated by the author. Read before the Royal Irish Academy.

† Mr. J. Turner, a large distiller of resine, has kindly sent me the following notes regarding the statistics of the production of these oils on a manufacturing scale:—

	Percentage.
"Resin spirit" (boiling at 135° C.)	5·3
Heavy oils	64·6
Pitch	14·4
Gaseous products and H_2O	15·7

‡ Schiel.

§ I shall use the term "resin spirit" throughout this paper, to designate the light oils got on rectifying resin oils.

line mass for analysis. It seemed to have suffered no decomposition, exclusive of dehydration, and formed a friable and nearly perfectly white substance.

On making a combustion of the above, 0·218 gramme gave 0·505 gramme CO_2, and 0·218 gramme H_2O.

In a second experiment, 0·307 gramme of the fused mass gave 0·7076 gramme of CO_2, and 0·324 gramme of H_2O.

These experiments point to the empirical formula $C_{10}H_{22}O_3$.

	I.	II.	Theory.	
Carbon	63·16	62·86	63·15	120
Hydrogen	11 10	11·72	11·58	22
Oxygen			25·27	48
			100·00	190

The crystals obtained from an aqueous solution gave, when burnt, the following results:—0·265 gramme of crystals produced 0·557 gramme of CO_2, and 0·270 gramme of H_2O.

		Theory.	
Carbon	57·35	57·70	120
Hydrogen	11·32	11·53	24
Oxygen		30·77	64
		100·00	208

Colophonic hydrate $C_{10}H_{22}O_3 : H_2O$.
Colophonine $C_{10}H_{22}O_3$.

Colophonine is, therefore, isomeric with terpine hydrate, or is, more properly, a homologue of terpine. It is another instalment towards filling up an interesting series. This compound is probably derived from terebene.

Hydrocarbides.	Products formed therefrom by the occult molecule H_2O ("Turpentine Camphors.")	Hydrates.
$C_{10}H_{16}$, $C_{10}H_{16}$. ("Diterebene.")	$C_{10}H_{16}.C_{10}H_{16}$; H_2O.* ("Terpinole.")	
$C_{10}H_{16}$. (α) (Turpentine, or "terebenthene.")	$C_{10}H_{16}$; H_2O ("Liq. Turpentine Camphor.")	$C_{10}H_{16}$: H_2O; H_2O. Hypothetical hydrate, supposed transition products
	$C_{10}H_{16}$; $2H_2O$. ("Terpine.")	$C_{10}H_{16}$; $2H_2O$; H_2O (Terpine hydrate.)
$C_{10}H_{16}$. (β) ("Terebene.")	$C_{10}H_{16}$; $3H_2O$. (Colophonine.)	$C_{10}H_{16}$; $3H_2O$; H_2O. (Colophonic hydrate.)

In the above table I have endeavoured to convey, by the punctuation, the accretion of the series, and the different degrees of molecular integration.

It will be observed that each hydrate would be isomeric with the next higher homologue in the camphor series. The hydrates to the first two in the series are wanting, but it is probable that they exist, as the compound called liquid turpentine camphor is, in the presence of water, converted into terpine, the isomer of its hydrate. If we do not suppose that the hydrate is first formed, we could hardly account for the formation of terpine.

Colophonic hydrate was violently acted on by bromine, accompanied by a copious separation of carbon and hydrobromic acid. In water, the action was more manageable, and the ultimate product was a brominated oil, which, after washing, first with a diluted solution of carbonate of sodium and then with water, was dried over sulphuric acid. 0·471 gramme of this oil, after being decomposed in a sealed tube with pure soda, was treated with an excess of nitric acid and nitrate of silver. It gave 0·766 gramme of bromide of silver, agreeing very nearly with the formula of a tetrabrominated compound.

Professor Jellett, who kindly examined this substance for me as regards its optical properties, finds that it is perfectly inert when in solution, and possesses neither right nor left-handed rotation.*

As previously stated, the light oils from resin when treated with sulphuric acid, and then with water, produce a green substance. This colouration is, however, due to the presence of colophonic hydrate. On treating that compound with acids, a series of striking phenomena is exhibited, conjugated acids being formed, which exhibit a fine display of colours. The generality of these are green. Sulphuric, phosphoric (monobasic and tribasic), arsenious, citric, and tartaric acids give these reactions.

On treating the crystals with an excess of the acid, and then adding spirit, the colour is developed. It is necessary to use heat in most cases. The sulphuric acid reaction is capable of rendering evident a milligramme of the new substance, if properly applied. It is not necessary to use heat in this case. Under certain circumstances, hydrochloric acid is capable of producing this green reaction; but when colophonic hydrate is treated with an excess of strong hydrochloric acid, after the expiration of half an hour, a brilliant rose colour is developed on pouring it into alcohol. If the experiment is pushed further, different shades of violets are produced, until the ultimate result of the maceration is a magnificent indigo blue.

Terpine hydrates do not give any of these reactions. The coloured solutions give absorption spectra, represented by the accompanying diagram. The longitudinal lines *A*, *a*, *B*, *C*, &c., represent the position of the solar lines. The thickness of the dark bands represents intensity of absorption, in a similar manner to Bunsen's graphic method used for metal spectra. Fig. 1 is the spectrum seen on viewing an alcoholic solution of the sulphuric compound. Dr. Reynolds, to whom I showed this spectrum, noticed that, when the acid is first mixed, the spectrum shows an absorption between the lines *D* and *E*, *β*, Fig. 1; this, however, after a little time, begins to fade from its more refrangible end, the centre of the spectrum gradually clearing, until the band is lost, and the spectrum, Fig. 2, obtained, the band *a*, *a'*, being intensified. Hydrochloric acid spectra behave in a somewhat similar manner, the ultimate result, either from age or boiling, being a spectrum similar to Fig. 3, the bands *a*, *a'*, slowly fading. These results would lead to the inference that the normal colour is purple, which is afterwards converted into the green compound.

As regards the origin of colophonic hydrate, it is probably formed under similar circumstances to the terpine camphors, *i.e.*, by oxidation, or the assimilation of the elements of water. I have failed, however, in forming this substance artifically by oxidising the resin spirit with nitric acid.†

* Formed by the action of dibromhydrate of citrene on acetate of silver—

$$2(C_{10}H_{18}Br_2) + 4(C_2H^3AgO_2) - 4(AgBr) - 2(C_2H_4O^2) - \left.\begin{matrix}C_2H_3O\\C_2H_3O\end{matrix}\right\}O = {}^{C_{20}H_{34}O.}_{\text{(Terpinole.)}}$$

Vide "Naquet's Principles," p. 396.

* It does not differ in this respect from its congeners the terpine hydrates, and similar products, in which, although the hydrocarbide preserves its integrity, its gyratory power is suspended.

† Mr. Turner forwarded me from England a bottle containing resin spirit, in which he had observed crystals. They proved, on examination, to be colophonic hydrate. The bottle originally contained about 8 ounces, but, from evaporation, only ½ an ounce remained; it consisted of about 25 per cent of colophonic hydrate. It had been exposed to sunlight for about eight years—light, however, is not essential to the formation of this compound.

It is not present in newly-prepared resin spirit, as I have already explained; and, as my supply of colophonic hydrate was expended, my researches upon this substance were, I am sorry to say, brought to a close. It is, however, my intention to renew them at a future period.

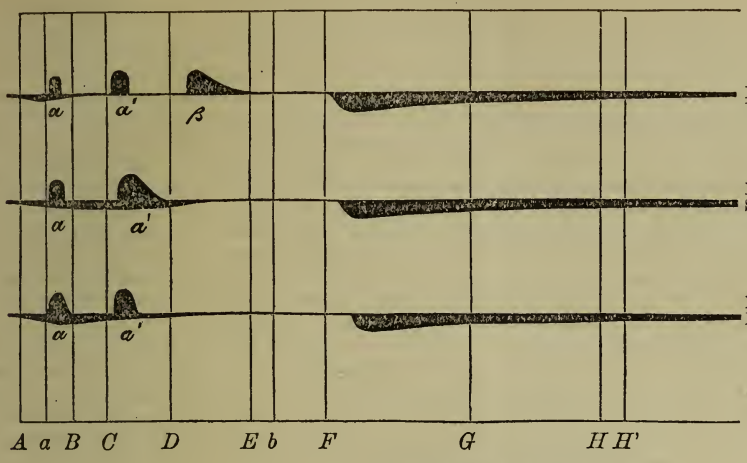


Fig. 1. H_2SO_4, or HCl. When first mixed.

Fig. 2. H_2SO_4. Strong alcoholic solution.

Fig. 3 H_2SO_4. Diluted alcoholic solution.

CONTRIBUTIONS TO OUR KNOWLEDGE OF

NATURAL WATERS USED FOR DRINKING AND OTHER DOMESTIC PURPOSES.

Whatever can serve for the purpose just named cannot but be highly acceptable at a time when the question of water supply, purity of water, and the origin therein of substances deemed by some injurious, and indicating its contamination with the products of the decomposition of animal matter, is daily discussed. It is not our intention to enter upon speculative ground, but we will simply place before our readers a few facts, relating to the natural history of various kinds of water investigated by the Royal Committee appointed for the purpose of making a thorough inquiry into all matters relating to potable waters, and those used for domestic purposes, in the kingdom of the Netherlands, which facts, including chemical analysis, microscopic investigation of sediments, engineering, and geological matters, have been embodied in a printed report. We have selected those samples of water which, for their peculiarities in some respect or other, are best fit to bear especially also upon the question *how* and *whence* ammonia and nitrates, as met with in natural waters, are derived.

We have to call attention first to some facts which are, especially in this country, rather overlooked; to wit—(1) that, although the larger portion of the Netherlands territory in Europe is of comparatively very recent geological formation and consists of strata of very great permeability for water, that permeability exists in almost all kinds of geological formations, and, therefore, in all countries, hence the water of rivers, lakes, sea and other water-courses penetrates, to greater or less extent and depth, into the soil and contributes with the water fallen as rain and snow to fill the springs and more or less deep wells.

The second observation relates to an essential difference in the primitive source of the water of the British rivers as compared with, for instance, that of the Rhine; for the sake of illustrating what we mean, we will just briefly quote a few facts and figures, first about the Rhine, and next about the Thames. The Rhine has its sources in that portion of the Swiss Alps called the St. Gothard group, at an elevation above sea level of 9,967 feet; it is fed by the constantly melting ice and snow of the higher peaks of the Alps, and its three main constituent rivulets flow into one at Reichenau, at a height of 2021 feet above sea level; thence to the lake of Constanz or Bodensee the river takes its course over a hard, rocky bed; it traverses the lake just named, which, by-the-by, is exceedingly deep, and contains water of great purity. The direct course of the Rhine has a length of 415 miles, its basin has an area of 65,280 square miles, and its tributaries, large and small, number fully 12,000.

The Thames, although not the largest of British rivers, is, undoubtedly, the most important in many aspects beside commercial; it takes its origin from some rather insignificant brooks and rivulets near Cirencester; at Thames Head Bridge its level is 376 feet above that of the sea; its direct course to the Nore is 124 miles, and the area of its basin is 6,160 square miles. What is, however, of far more importance in this comparison of these rivers for our purpose, is the fact that, throughout its entire course, and especially previous to the point of bifurcation, the waters of the Rhine essentially retain that purity which gave rise to its being named in Switzerland, "*Reiner*" (purity). Dr. Von Planta Reichenau, an eminent Swiss *savant*, and the owner of large estates on and near the sources of the Rhine, has analysed its waters, taken at different seasons of the year and at different places of the course of this river, from Reichenau downwards to Emmerich, and has found that, what is in a very high degree the case with these waters at their primitive source, is retained in a very marked measure over this entire length of the river's course, viz., that the water always contains, dissolved, a large and abundant quantity of oxygen: this, coupled with the fact that the large bulk of the water of this river is not, to any great extent, modified by the water of its tributaries, some of which are large streams also taking their origin in ice and snow, may have some bearing upon the very small quantity of organic matter and the infinitesimal small quantity of ammonia met with in the water of the Rhine.

Sufficient has been said to point out that there exists

a primitive and essential difference between the sources of the supply of water of the Thames and Rhine to account for more impurity in the latter, while, moreover, the value of manure of all kinds is too greatly esteemed along the mayor portion of the course of the Rhine to allow fæcal matters and other refuse and offal to find its way into a river, the police of which, or, rather, *administration de la sureté publique*, about which is under the control, not of one state, but of that of France, Baden, Bavaria, Hesse-Darmstadt, Prussia, and the Netherlands, jointly, whereby proper care is also taken as regards the fouling of the river and the pollution of its waters. Except in the Netherlands, and excepting also the men who, while navigating the Rhine or its tributaries, drink of its waters, that water is not used for drinking purposes by the great bulk of the large population dwelling on the banks of that river, since excellent water of easier access than that of the river is readily to be had. The writer of this article had, last year, while in Germany, an opportunity of obtaining some information about the supply of water, quantity, and quality, in use by the large numbers of soldiers at Coblentz, Cologne, Wiesbaden, and other places; great care has been taken to insure a constantly plentiful supply, and, above all, of good quality, by boring deep wells. Notwithstanding, the river water is excellent to the taste, rather less saline, however, and is certainly better for washing purposes, neither the military nor civil population of the places just named, and others situated along the Rhine, Moselle, Lahn, Maine, &c., ever think of using the water of these rivers, which, in many instances, indeed, they would have to fetch at a comparatively great distance from their dwellings. The writer was also informed that the water obtained from the public pumps, pants, and fountains, was regularly submitted to analysis, and that the authorities took great care to keep wells, and tubing, and all works in proper repair, so as to insure good and wholesome water.

Turning now to our chief subject, we quote, in the first place, the results of analysis, and other particulars of the water of a canal at Zwolle. This canal is so connected with the Züyder Zee and tidal rivers that its level, by the effect of the flood and ebb, varies about 13 inches daily; the water was clear, pale yellow coloured, its taste somewhat similar to rain-water; on standing, it deposited a sediment, which, on being submitted to microscopic research, proved to contain not only minutely divided mineral matter, but also various infusoria, remnants of partially peatised vegetables, and small molluscs.

The result of the chemical analysis in this, as in every following instance, refers to *one* litre of the water, and the quantities are expressed in grammes—Total solid residue, 0·181; organic matter, 0·020; sulphate of lime, 0·0087; carbonate of lime, 0·0008; alkalies, 0·066, consisting chiefly of chlorides without any sulphates; ammonia, 0·00023; nitrates or nitrites, none; colour of dry residue, yellow before ignition, grey after. This water is not liked for drinking or domestic purposes, but occasionally used.

Water from a Pump at Groningen.—The well supplying this water is in very permeable soil; from the surface to a depth of 2·7 metres, layers of peaty soil are found; next follow sand and gravel. At 3·5 metres distance from the pump, an open sewer—a dirty ditch—runs. The water of the well is undoubtedly partly surface-water. Its physical properties are—Dark yellow colour; somewhat milky turbidity; taste not disagreeable, but very vapid. The microscopical examination of the sediment led to no other result than that structureless membranes were seen, which disappeared when a single drop of dilute hydrochloric acid was added, causing, at the same time, effervescence. Analysis yielded the following results:—Total sold residue, 1·386; organic matter, 0·225; sulphate of lime, 0·1094; carbonate of lime, 0·6556; alkalies, 0·396, consisting chiefly of chlorides without any sulphates; ammonia, 0·00790; nitrates, or nitrites none; colour of dry residue before ignition, brown; after, black. Almost all who reside in the neighbourhood where this pump is placed detest the water; it is only used after having been left quietly standing for at least twenty-four hours, and then only after having been boiled and cooled again. At the time the water was taken for analysis, much rain had fallen The city of Groningen is situated at a considerable height above sea-level, as compared with many other places of the kingdom.

Water taken from a Brook situated near Leeuwarden, in the Alluvial Soil of the sea formerly existing there.—The bottom of this brook consists, for about 2 metres depth, of a layer of partly-decayed fresh-water plants. At about 150 metres distance from the brook, a large dung-heap is permanently placed. Physical properties of this water—Nearly colourless; quite limpid; tastes like rain-water. After long standing, a very slight sediment is deposited, which, on microscopic investigation, was found to consist of very small molecules, and flocculent vegetable matter, containing the very lowest order of infusoria. Result of chemical analysis—Total solid residue, 0·5135 gramme per litre; organic matter, 0·0675; sulphate of lime, 0·0583; carbonate of lime, 0·2617; alkalies, 0·126, chiefly chlorides without any sulphates; no ammonia, and only very faint traces of nitrates; colour of residue before ignition, yellow; after, greyish black. This water is largely used by the inhabitants, and very well liked. At the time the water was taken for analysis, not much rain had fallen. The level of the water in this brook is 47 centimetres below A. P.,* which is about sea-level.

Water from a Pump at Dokkum.—This pump is placed on a now disused cemetery. The water is collected in an underground vault made of masonry. The level of the water is 2·45 metres below the surface of the pavement, and is evidently also fed by a canal which is situated at about 100 metres distance from the vault. No sewers are anywhere in the neighbourhood; but close to the pump is a building used as a schoolhouse, and this place being unprovided with an urinal, the boys (200 in number) are in the habit of making their water outside the school, against the wall, in consequence whereof the soil in the immediate vicinity of the pump is saturated with urine. The water is about colourless, clear, and limpid, and not at all disagreeable to the taste. A sediment subsides after some time; and this, on being investigated with the microscope, was found to contain molecules of clay, very small vegetable seeds, and pieces of threads of white wool and blue cotton. Total solid residue, 1·6935; organic matter, 0·1550; sulphate of lime, 0·4669; carbonate of lime, 0·2831; alkalies, 0·7885, chiefly chlorides without any sulphates; no ammonia; no nitrates or nitrites; residue yellow before ignition, grey after. This water

* A. P. stands for *Amsterdamsch Peil*, which is the starting point, or zero, from which all levels below or above are measured in Holland. This true and very accurately-determined point was first adopted at Amsterdam about the year 1680; and, after having been verified over and over again, has been, since 1818, adopted as the general zero of all levels in the country.

is not much used, except by the schoolboys. At the time the sample was taken for analysis, there had been a good deal of rainfall.

Water from a Canal called the Dedemsvaart, Province of Overijssel.—This water is derived from the extensive peat bogs, to which the canal gives ready access. Its colour is as dark as sherry, but it is limpid and clear; taste vapid and disagreeable. The sediment which subsides exhibits, when viewed under the microscope, a multitude of peatified vegetable substances and infusoria. Total solid residue, 0·131; organic matter, 0·080; sulphate of lime, 0·0146; carbonate of lime, 0·02854; alkalies, 0·021; no sulphates; ammonia, 0·00041; of nitrates rather a large quantity; residue brown, black after ignition. While burning, it gives off an odour resembling that of smouldering nitrogenized organic matter. No rain had fallen for several days when the sample of water for analysis was taken. This water is not used for drinking or domestic purposes.

Water from a Pump surnamed the "Staten Pump," at the Hague.—This pump is placed close to one of the most ancient buildings in the said town, and stands on a comparatively high level. The level of the water in the well is about 5 metres below the pavement. A thin brick wall only separates this pump and well from an extremely foul and dirty canal, a rather large open sewer, which winds its course to a large canal named "Spui." The water is rather turbid; does not become clear on standing; exhibits a yellowish colour; taste saline; no microscopic investigation. Total solid residue, 0·750; organic matter, 0·060; sulphate of lime, 0·0639; carbonate of lime, 0·1831; alkalies, 0·443; no sulphates of alkalies; ammonia, 0·01181; large quantity of nitrates; colour of residue before ignition yellow, after ignition grey. This water is largely used, and relished by those who reside near enough to make it worth their while to fetch it.

Water from a Pump situated in the Cité Ouvrière belonging to M. Régout, at Maestricht.—This pump is of comparatively recent construction, is in good working order, and the well is built in by means of brickwork laid in strong hydraulic cement; a canal is at 159 metres distance. No infiltration of surface water, nor of the contents of a large underground sewage cistern, has been found to exist. The water is of excellent quality, quite clear, colourless, and pleasant to the taste. Total solid residue, 0·650; organic matter, 0·020; sulphate of lime, 0·043; carbonate of lime, 0·342; alkalies, chiefly as chlorides, 0·245; no sulphates of alkalies; no ammonia; no nitrates nor nitrites. The soil in and about Maestricht is full of fossils, and noted for having been the place where very interesting animal remains have been found, while, moreover, the town, in consequence of having been since at least three centuries a fortress, and having frequently been besieged for months together, is, in a sense, a vast cemetery, full of the human remains of soldiers killed during such sieges and interred within the town, which, however, is of large extent of surface. Colour of solid residue of water before ignition, pale brown; after ignition, greyish black. The water is largely used, and very much praised and relished.

Rain-water Collected at St. Annaland, Province of Zeeland, at no great distance from the Sea.—The water was taken from a large, well-made, underground cistern, used for storing the water, built of bricks and strong cement; the water, on falling on a tiled roof, is led by means of wooden spouts to the cistern, which is surrounded by sand and clay soil; the water was slightly coloured, somewhat turbid, but does not deposit a sediment; taste, the same as is usually experienced from rain-water. Total solid residue, 0·4775; organic matter, 0·055; sulphate of lime, 0·136; alkaline chlorides, 0·2085; alkaline sulphates, 0·004; no ammonia; a very faint trace only of nitrates; colour of residue, before ignition, pale yellow; after ignition, pale grey. The water is much used, since there is no other but brackish water, quite unfit for any use.

Water taken in the Middle of the River Merwede (a local name given to a portion of the Rhine after the river Maas has joined it near Woudrichem).—Off the town 'of Dordt, the river is at this point about 1200 metres wide, and rather deep. The water was taken about the middle of the month of March last year. The water was very turbid, did not become clear on standing, and its taste was disagreeable. Total solid residue, 0·160; organic matter, 0·040; sulphate of lime, 0·0355; carbonate of lime, 0·420; alkalies, chiefly chlorides, 0·0425; sulphates of alkalies, none; ammonia, none; of nitrates, a faint trace; colour of solid residue, before ignition, pale yellow; after, pale greyish. This water is largely used, but in many households it is filtered previously.

Water from a Well bored, in 1866, at the Hague, for the private use of a Manufactory.—Total depth of boring, 5·65 metres, passing through 1·05 metre of sand; 0·40 metre of blackish peaty soil; 1·0 metre pure peat bog; 0·70 metre sand and peaty veins; 1·50 metre bluish-coloured sand; 1 metre white-coloured sand mixed with shells of molluscs; the water leaves 0·704 gramme to the litre of solid residue dried at 120° C.; organic matter, 0·198; carbonates of lime and magnesia, 0·192; chloride of sodium, 0·247; sulphuric acid, 0·206 gramme to the litre; no ammonia, and no nitrates nor nitrites have been detected in this water, although diligently sought for in a large quantity of water carefully evaporated to small bulk; the water is not colourless, but excellent to the taste, and the supply very abundant.

Results of the Analysis of Three Varieties of Water, obtained at Rotterdam by Means of Norton's Well Tube, driven into a Layer of Whitish coloured Sand.—No. 1 well is 23 metres deep below sea level; No. 2 well has the same depth; No. 3 is about 14 metres below sea level. The physical qualities of these waters are good; the water has risen within the tube to about 1 metre below the surface of the mouth of the tube, which is level with the soil wherein it is driven.

	I.	II.	III.
Total solid residue	0·708	0·320	0·448
Organic matter	0 146	0·094	0·094
Carbonates of lime and magnesia	0·204	0·068	0·170
Chloride of sodium	0·098	0·029	0·093
Sulphates, calculated as SO_4	—	0 c0.4	—
Ammonia	0·021	0·020	0·011
Nitrates	Decided reaction.	Decided reaction.	Very strong reaction.

The analyses of the few samples of water selected for quotation from upwards of 300 analyses published in the report, represent the varieties of water used for domestic purposes in the Netherlands; to wit, rain-water, river-water, water from brooks and canals, water taken from more or less deep wells, sunk or bored, into the ground to more or less depth, but never reaching to

layers of very solid, and never to what should be properly called rocky, material. The localities selected are situated many miles distant from each other. As regards the alkalies, potassa and soda, it should be observed, that while generally no sulphates of the same are met with, a portion of these substances is very frequently combined in the waters analysed with humic, ulmic, crenic, and apocrenic acids and other organic substances. The composition of the water of the great rivers, passing through the country, does not materially differ at any point of their course as long as that water remains potable, from not being within sea reach, when the samples are taken at the same period of the year.

SPECTROSCOPIC OBSERVATIONS OF THE SUN.*

BY LIEUT. J. HERSCHEL.

This letter, written from Bangalore, states that the author discovered a new line in the spectrum of the sun's rays, in the neighbourhood of G; the author determined its position without difficulty, with reference to the rest of that crowded group of solar lines, and found it identical with the thick line at 2796 of Kirchhoff's chart; while studying this newly-discovered line, the writer succeeded in distinctly seeing a fainter red flash, already described by Mr. Lockyer, and he also noticed another line (the 6th) between F and G. These lines are defined by the figures of the Greek alphabet, and their number and position indicated according to Kirchhoff's chart. The letter then enters into details of mode of observation, and proceeds to discuss an article by Mr. Huggins in the *Quarterly Journal of Science*. This part of the letter, however, is not suitable for abstraction.

ON SOME GENERIC REACTIONS IN ORGANIC CHEMISTRY.

BY S. E. PHILLIPS.

Organic chemistry has been variously defined: I would represent it as essentially "the chemistry of generic reactions."

It is mooted that a fuller recognition, and a more systematic study of a few widely-generic reactions, may do much to bring about a more simple outline classification of the vast wonders of organic combinations.

These reactions have been recognised in their simplest expressions; but it has not been so clearly shown that they extend into regions of great intricacy, where the guidance of law is so much needed in the discrimination of complex types of combination.

Astronomy and geology have aspects of immensity which engage and entrance the noblest powers of human intellect, nor is chemistry in any way inferior as another receding horizon of infinity.

These aspects are, indeed, the inverse of dissolving views, for it is the reward of genius, of labour, and sacrifice, to decipher, out of the dim chaos, minarets and pinnacles of architectural beauty, which entrance the mind and afford a pleasure that never satiates; and every line traced adds a new lustre, and a richer meaning, to those already drawn.

Moral and physical truth have a distinction only in a human or circumferential sense. All aspects of divinity coalesce and commingle towards an effulgent centre of infinite harmony; hence poets have been co-labourers with our profoundest philosophers and physicists in promoting the conviction that—

> "Discord is harmony ill-understood;
> All partial evil, universal good."

In offering these thoughts as an amateur, in presence of men whose abilities and means of investigation are greatly superior, some apology or explanation may be desirable.

The sincere desire is to write in a humble spirit of enquiry, rather than of dictation.

It is true that most English chemists have adopted the new notations; but, seeing that in the continental journals fully one-half the articles are written in old style, and that so great an authority as Dumas does not hesitate to express entire inability to read modern chemical memoirs, owing to their complex types and "barbarous" nomenclature, surely it may be forgiven in an unpretending student to express long-pent-up thoughts in what appears to him as the clearest and simplest language, the more so as his object is purely to ventilate principles (which are independent of modes of representation), and also to challenge students of the modern ways, to see if they can penetrate deeper or see further into the wonderful labyrinth.

The pretentious methods of modern notation are certainly curious in their way; and it is refreshing to see the tone of sober-minded reaction which has been evinced at the recent discussions of the Chemical Society.

One of the most prominent facts of general chemistry is that hydrides are "indifferent bodies"—they do not combine without decomposition—yet Professors Hofmann and Wanklyn see in these prolific sources of substitution, and even of direct dedoublement; they are prominent in the diamines and triamines of the former, and to the latter they are leading types to which other definite chemical combining bodies may be referred:—

Ethylene. $C_4\begin{cases}H\\H\\H\\H\end{cases}$

Hydride of ethyl. $C_4\begin{cases}H\\H\\H\\H\\H\\H\end{cases}$

Rosaniline. $C_4\begin{cases}NHC_{12}H_5\\NHC_{12}H_5\\NHC_{12}H_5\\H\end{cases}$

Leucaniline. $C_4\begin{cases}NHC_{12}H_5\\NHC_{12}H_5\\NHC_{12}H_5\\H\\H\\H\end{cases}$

M. L. Henry holds that salicylic alcohol is an *aldehyde* as well as a *phenol*, and that by chloro-variation it gives the following series:—

Salicylic alcohol, $C_6H_4<^{HO}_{CHO}$

Doubly-chloruretted cresol, $C_6H_4<^{HO}_{CHCl_2}$

Triply-chloruretted toluol, $C_6H_4<^{Cl}_{CHCl_2}$

Chloruretted aldehyde of salicyl, $C_6H_4<^{Cl}_{CHO}$

Whether the first really be an alcohol, or the last an

* Abstract of a letter addressed by the Author to W. Huggins, F.R.S., and communicated by him to the Royal Society.

aldehyde, is by no means certain, or even apparent, so random are these type-building speculations. And it seems strangely overlooked that the old radical theory is, peradventure, adequate to explain all these substitutions without any such paradoxical nomenclature.

The first pair, as *hydrides*, would be—

$(C_{14}H_5O_4),H$ and $(C_{14}H_5O_2),H$;

the second pair are evidently chlorides—

$(C_{14}H_5Cl_2),Cl$ and $(C_{14}H_5Cl_2O_2),Cl$;

as *alcohols* the first pair would be—

$(C_{14}H_5O_2)O+HO$ and $(C_{14}H_5Cl_2)O+HO$

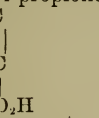
Another authority, speaking of an acid derivative of mesitylen, $C_{18}H_{11}H$, says $C_9H_6O_6-3CO_2=C_6H_6$, therefore it is a benzol with 3(COHO), substituting 3H!

In order to parallel the cogency of this logic, I would say of the thousands or millions of organic bodies which similarly break up into oxalic acid, that, therefore, they are oxalic acid with the infinity of residues replacing, &c., &c.

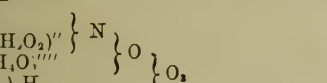
M. Schorlemmer, before the Royal Society (Chem. News, vol. xix., p. 196, *Am. Reprint, June*, '69, *p.* 303), says, the oxidation products of propylic glycol are carbon dioxide, and acetic acid, which proves that the structure of the glycol is expressed by the formula $CH_3—CH(OH)—CH_2OH$.

Another authority, with like wonderful prevision, says that hydrocinnamic acid is $C_6H_6+CH_2—CH_2—COHO$, and the saltic type is $(C_9H_9O_2)_2Ca+1\frac{1}{2}H_2O$.

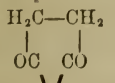
Another insists that the acid, with 2H less than cinnamic acid, $C_{18}H_7O_2+HO$, and therefore $C_{18}H_5O_3+HO$, coumaric acid, is phenyl-propiolic acid—



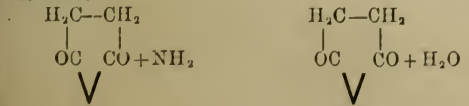
Professor A. Matthiessen thinks that all the reactions of narcotine may be accounted for by the following rational (?) formula:—



By a singular distortion of an intellectual process, some have thought that the simple principles of mineral chemistry might be employed to gradually unravel the greater complexities of organic combination. Professor Wanklyn has corrected this error, and shown that, in the simple salts and hydrates of soda, lie hidden the mysteries of triatomic and septatomic quantivalence: we must not go from the simple to the complex, but rather work out principles or fantasies from organic chemistry, and then apply them to the old binary compounds of mineral chemistry. Time was when the relation of acid to amide was a matter of great simplicity, but M. Erlenmeyer now sees much farther. Succinimide is—



and its origin from anhydrous succinic acid and ammonia is thus:—



To give but a faint description of these modern pleasantries of atomic mechanism would fill large volumes. We can only add in this brief glance, that they are from men of undoubted eminence and great practical ability.

Enough has been said to justify our hesitation in adopting any of these multifarious modes, and in the pressing desiderata to lay hold of some wide generic principles which may afford some comprehensive grasp of the whole contour of organic metamorphosis; we humbly, and *pro tem.*, fall back on the old binary principles of Berzelian and Lavoisierian chemistry, as best fitted for the widest and most comprehensive grasp.

We assume, until a wider and better theory can be offered, that such radicals as methyl (C_2H_3), ethyl (C_4H_5), propyl (C_6H_7), acetyl (C_4H_3), and a vast infinity of analogues do exist, and that, as hydrides, they are characteristic indifferent bodies, while with O, Cl, S, and other negative elements they form bases or acids, and other more neutral bodies, perfectly paralleled by the more simple elements of mineral chemistry.

The confidence and dogmatism with which such types and names as we have indicated are obtruded upon notice will be in no way imitated. We shall try to lay hold of leading types, ever bearing in mind that they must necessarily be subject to manifold ways of isomeric variation. The ground to occupy is of too wide and extensive a character to permit of special exactitude; but this attitude should in no way be opposed to rigid scrutiny or microscopic investigation at any stage of the process. The harvest is indeed ripe, and manifold labourers are wanted in every direction; workers in the laboratory and watchers of the wide horizon. Our meaning in this direction will perhaps be better understood by an illustration.

We deem, then, the term phenyl-propiolic acid almost as barbarous as the older term, "sulphuric ether." Now that we have an infinity of ethers, including a true sulphuric ether, it surely behoves us to carefully control their nomenclature.

In what way the radicals phenyl and propyl may combine to form the acid in question is a legitimate matter of detail, nor can we afford to wait long upon such minutiæ. To us the great question is, Is there a hydro-carbon radical ($C_{18}H_5$) comparable with acetyl (C_4H_3), or cinnamyl ($C_{18}H_7$), &c., &c.?

Our meaning may further be seen in regard to the body aceton, $C_6H_6O_2$. Its origin and subsequent reactions led very generally to the idea of its being a hydride of acetyl, $C_4H_3O_2,H$, in which the H was replaced by the gaseous methyl (C_2H_3) = $C_4H_3O_2,C_2H_3$.

While recognising the validity and value of this aspect as one of the elements of isomeric variation, yet would we stoutly urge the great necessity for a due subordination of this phase of organic combination. To give it undue prominence, as is too often done, and coin a shibboleth of hard names, is positively confusing and detrimental.

It has only just transpired that, by the simple and direct oxidation of the hydrocarbon propane or hydride of propyl, we get a body possessing all the characters of acetone, $C_6H_6O_2,H$.

The distinction between the two types is one of great importance, because the hydrocarbons proper are comparatively few and capable of a simple generic classification, while such types as acetone, $C_4H_3O_2,C_2H_3$, are capable of an infinite variation, nor do I see any hope of embracing them in any generic arrangement.

[English Edition, Vol. XX., No. 505, pages 49, 50.]

It only remains in this short introduction to offer a few thoughts as to why we still adhere to the old notation in regard to O, S, C, and other doubled atoms of modern theory.

Among other reasons, O is doubled because its ordinary volume is half that of H. The same anomaly subsists in the volumetric character of the phosphorus, arsenic group, and some have pushed theory so far as even to double these, but that is generally discountenanced on the ground that the anomaly disappears in their various compounds, where the volumes agree with the atomic weights in a way perfectly comparable with the one volume, N.

			Density.	Atomic Weight.
Ammonia....	H_3N	2 vols.	17	17
Phosphonia...	H_3P	"	34	34
	&c., &c.			

We moot that the same argument is strictly applicable for oxygen also.

It is monatomic and replaces chlorine, &c., in organic radicals where the volumes correspond normally; in other words, the densities are as the a omic weights.

			Density.	Atomic Weight.
Hydride of acetyl	$(C_4H_3O_2)H$	2 vols.	22·04"	44
	$(C_4H_3Cl_2)H$	"	49·70"	99
	&c., &c.			

Hydrides are normally two vols., whence their densities are half their atomic weights, but these radicals themselves are normally one vol., and their densities exactly correspond with the atomic weights.

		Density.	Atomic Weight.
H.....	1 vol.	1	1
$(C_4H_3O_2)$....	"	43	43
$(C_4H_3Cl_2)$....	"	98	98
	&c., &c.		

Also in organic acids the densities and atomic weights agree in innumerable cases of proto-, sesqui-, bi-, and tri-acid forms where chlorine and oxygen are perfectly paralleled.

Again, oxygen, in conjunction with C = 6, and S = 16, replaces H in ammoniacal types, and here also the densities and atomic weights agree.

	H_3N		Density.	Atomic Weight.
Ammonia.....	HH_2,N	2 vols.	8·5"	17
Ethyl mustard oil	$(C_4H_5)(CS)_2,N$	"	43·7"	87
Methyl "	$(C_2H_3)(CS)_2,N$	"	37·8	73
Amyl "	$(C_{10}H_{11})(CS)_2,N$	"	63·4	129
Butyl "	$(C_8H_9)(CS)_2,N$			
	&c., &c.			

and, by a generic action, these, by addition of ammonia, form fluosinnamin types of sulph-ureas.

Urea.....	$H(CO)_2H_3N_2$
Fluosinnamin.....	$(C_6H_5)(CS)_2H_3,N_2$
Butyl sinnamin.....	$(C_8H_9)(CS)_2H_2,N_2$
&c., &c.	

Lastly. Monatomic oxygen replaces H in the general phenomena of substitution, mainly like chlorine.

The oxidations, chlorodations, and sulphodation of carbydrogens, rich in hydrogen, present a unity of action; and the bases split up to negative or acid forms, by similar intermediate stages of hydride or indefinite bodies, where O=8; S, 16; and Cl, 35·5, replace each other with volumes and atomic weights in perfect harmony.

We now take a glance at the amide and glucoside modes of production.

Amides.

The study of these bodies some years ago afforded the writer great interest:—

1. As possessing such new and varied phases of ammoniacal type.

2. As proving the adequacy of plain and simple principles to guide without ambiguity or mystification into the profound depths of the science.

3. As proving that *one generic formula of reaction* or production seems to give amides, hydramides, ureides, or ureas, amide acids, urethanes, &c., &c.

4. As proving the strongest arguments against the modern doctrines of mono-, bi-, and tri-basic acids, and the similar mono-, bi-, and tri-amines.

In this connection I can only refer to one aspect of this wide field, viz., its tendency to resolve hitherto unexplained groups of organic combination. If I mention two such groups it is not so much because success appears to attend the very onset, as to elicit a co-operative or corrective criticism.

On the one hand, I have long felt puzzled at the existence of an apparently aberrant group of carbohydrogens with even instead of odd ratios of H, and have marked out for investigation what may, perhaps, be called *the malic acid group.*

This group is exceptional in the even number of H atoms in the radical, whereas all other acid series have only odd numbers of H. A special study of this group might throw some light on the problem why all the carbon constituents have even numbers, and the H part odd numbers, while the oxygen seems normally to affect even numbers in the radical.

The first step in the process is evidently to apply the generic formula in question, and the peculiarity seems to stand that test, for

Malate of A—2HO gives Malamide.. .....$(C_4H_2O_3)H_3N$
Bimalate of A—2HO " Malamic Acid (Aspartic). $2(C_4H_2O_3)H_2N,O$
Aspartate of A—2HO " Aspartamide (Asparagin)..$2(C_4H_2O_3)H_4N_2$

Most books say that malamide or asparagin is found in the asparagus, in marsh mallow, and some other plants, but, although of the same composition, they are not identical, and I think my notation and a recognition of the ureal or atmonia type of asparagine will clear up the difficulty. I cannot see the least reason or advantage in doubling this acid to make it square with the modern notion of bibasic acids.

In "Fownes" (9th edition), its structure and derivation is compared with that of the oxamide series. In both cases, the acids and neutral salts are doubled, while the acid salts (binacids?) and their derived amides contain no more acid than the mono or neutral forms, and yet the prefix *bi* is retained.

I ought, perhaps, to have pointed out that, by an extension of the formula, when the acid is an ammoniacal one, then the result is an ureal amide, thus—

Carbamate of A—2HO=Urea.....$2(CO)H_4,N_2$
Aspartate of A—2HO=Aspartamide (asparagin).....$2(C_4H_2O_3)H_4,N_2$
&c., &c.

On the other hand, there seems a tolerably wide range of combination with unusual and intractable ratios of oxygen, and with little or no H in the compound, as in the

Mellitates,	$HO+C_4O_3$
Croconates,	$HO+C_5O_4$
Rhodizonates,	$HO+C_7O_7$
Saccharates,	$HO+C_6H_4O_7$
&c., &c.	

How, then, does this generic action apply to such cases?

Carbonate of	Ammonium	—2HO,	gives	Carbamide.
Bicarbonate of	"	"	"	Carbamic acid.
Oxalate of	"	"	"	Oxamide.
Binoxalate of	"	"	"	Oxamic acid.
Benzoate of	"	"	"	Benzamide.
Bibenzoate of	"	"	"	Benzamic acid.

$$H_4NO+CO_2-2HO=(CO)H_2N$$
$$H_4NO+2CO_2-2HO=2(CO)H_2N,O$$
$$H_4NO+C_2O_3-2HO=(C_2O_2)H_2N$$
$$H_4NO+2(C_2O_3)-2HO=2(C_2O_2)H_2N,O$$
$$H_4NO+C_{14}H_6O_3-2HO=(C_{14}H_5O_2)H_2N$$
$$H_4NO+2(C_{14}H_6O_3)-2HO=2(C_{14}H_5O_2)H_2N,O$$
&c., &c.

The infinity of amides thus produced are hydride, indifferent or non-combining bodies, mostly affecting the crystalline form of needles, and insoluble; in all probability they are of the type H_2N,H. Whatever ammonia is in type, constitution, and general properties, that, in all probability, are the amides.

The amic acids are ammoniums, H_4N,O, definite combining bodies, and de-doubling with basic, intermediate, or acid functions just in proportion as the substitutional equivalents rank higher or lower in the electro series.

Malate of	Ammonium	—2HO	gives	Malamide.
Bi-malate of	"	—2HO	"	Malamic (aspartic) acid.
Succinate of	"	—2HO	"	Succinamide.
Bi-succinate of	"	—2HO	"	Succinamic acid.

&c., &c.

It is curious to compare these simple and consistent notations with the confused variations of modern theory. Any fundamental appeal to the guidance of law is wholly lost in the doubling of atoms, and the varied estimates of water of hydration in the several compounds submitted to the amide formula.

In extending this list considerably, I am well aware there are chemical reasons for doubling the atom in some cases where, indeed, that process may, in all probability, be necessitated: I only contend that this should be done with extreme caution, and not without a survey of the several relations.

As to the doubling of succinic acid, I find the following remark in my rough notes:—"M. Fehling, and also M. Cahours, seem quite sure that succinic acid is tribasic, like the phosphates $3HO+C_8H_3O_5$; and, between the chemical reasons urged by the bi- and tribasic claimants, I could not see a pin's difference whereon to found a preference; but, where all is so empirical, the simple truth may have a strong advocate in M. Dopling, from whose elaborate paper I copy an extended series of succinates ($MO+C_4H_2O_3$), with the usual variation of type in ascending the series into the weaker bases, where two and three atoms of base are found, as in the corresponding acetates, sulphates, &c."

Many salts affect two volumes, but there are several whose densities are as one volume, as in the

Succinate of ethyl, $EO+C_4H_2O_3$,
Succinate of methyl, $MeO+C_4H_2O_3$,
Oxalate of ethyl, $EO+C_2O_3$,
Silicate of ethyl, $EO+SiO_2$,
Oenanthate of ethyl, $EO+C_{14}H_{13}O_3$,

and others.

The theoretical application of this formula to the second group would be thus—

Mellitate of A—2HO = Mellitamide?
Bi-mellitate of A—2HO = Mellitamic acid?
$H_4NO+C_4O_3-2HO=(C_4O_2)H_2N$?
$H_4NO+2(C_4O_3)-2HO=2(C_4O_2)H_2N$?

There is encouragement to think that these bodies may be obtained when duly sought for. Fownes says, "Mellitate of A yields, by distillation, two curious compounds—paramide, a white, amorphous, insoluble substance, containing C_8HNO_4 (*i.e.*, bimellitate of ammonia—4HO), and convertible, by boiling with water, into bimellitate of ammonia;" and euchronic acid, a colourless, soluble, crystalline body, containing, in the anhydrous state, $C_{12}NO_6,2HO$.

In this case, it is almost certain that paramide is the amide or ammonia form of mellitamic acid, evincing as it does the widely generic property of re-conversion, by boiling water, into bimellitate of A.

Here, then, we get a new substitutional representative of H; and, if one H can be replaced by (CO), (C_2O_2), or (C_4O_2), surely that does not end the series; and have we not more complex acids which may be explained by a similar process, and their radicals identified?

And, seeing that silicium is now so close a congener with carbon, may not a similar extension of law be applicable in the infinitely varied silicates of mineralogy?

Euchronic acid appears to be a varied mellitamic acid—thus, $3(C_4O_2)HN,O$.

Glucosides.

The manuals of chemistry present a strange variety of types in regard to the constitution of the sugars, and also complex acids containing higher ratios of oxygen; but there are considerations which seem to encourage the hope that both these intractable groups may, ere long, be embraced within the limits of simple law.

The hypothesis herein is twofold; 1st, That glycols, glycerines, mannites, and sugars are all monatomic alcohols; 2nd, That complex organic acids with high ratios of oxygen are substitutional variations of simpler types.

For a fuller exposition of these views, I must refer to a separate article on the constitution of the alcohols; but, for brevity, I here append a note on the aceto-nitrates, or, as I should prefer to call them,

Nitro-Acetates.

It is said that these belong to the water type $\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}O_6$, in which H_6 is replaced by ferricum $Ffe^{vi.}$, and 1H is replaced by (NO_2)

No. 1.
$\left.\begin{matrix}H_6\\H_6\end{matrix}\right\}O_6$
Type.

No. 2.
$\left.\begin{matrix}Ffe^{vi.}\\H_6\end{matrix}\right\}O_6+{}_2H_2O_2$
Normal ferric hydrate.

No. 3.
$\left.\begin{matrix}Ffe^{vi.}\\4(C_2H_3O)'\\(NO_2)'\end{matrix}\right\}O_6+4H_2O$
Tetra-aceto-nitrate of iron.

No. 4.
$\left.\begin{matrix}Ffe^{vi.}\\3(C_2H_3O)'\\(NH_2)'\\H_2\end{matrix}\right\}O_6+2H_2O$
Trio-aceto-nitrate of iron.

No. 5.
$\left.\begin{matrix}Sr''\\(C_2H_3O)'\\(NO_2)'\end{matrix}\right\}O_2$
Aceto-nitrate of strontian.

No. 6.
$\left.\begin{matrix}Ba''\\(C_2H_3O)'\\(NO_2)'\end{matrix}\right\}O_2$
Aceto-nitrate of barium.

If, in these compounds, (NO_4) really replaces 1H of acetic acid, and, further, presuming that, in the three and four atoms of acetic acid, only one atom is so modified, then the formulæ might be thus—

$$\left.\begin{matrix}\text{(No. 6). } 2BaO+AcO_3,HO\\\text{(No. 5). } 2SrO+AcO_3,HO\end{matrix}\right\}AcO=C_4H_2(NO_4),O_3$$
$$\left.\begin{matrix}\text{(No. 4). } 2Fe_2O_3+3AcO_3,7HO\\\text{(No. 3). } 2Fe_2O_3+4AcO_3,HO\end{matrix}\right\}1AcO=C_4H_2(NO_4),O_3$$

It only remains to compare these notations with the ordinary types of similar true acetates; and methinks all seems quite fair and simple; nothing strained, nothing outlandish. No new principles, no 6-atom water types are at all requisite! As to the 6-atom *normal* ferric hydrate, it is clearly $3HO+Fe_2O_3$.

What is this ferricum if it be not 2 atoms of ferrosum? and yet this latter is said to be tetratomic, while the former is hexatomic!

Ferrosum=Fe^{iv}=(56). Ferricum=Ffe^{vi}=(112). As a general rule in such cases of substitutional variation, I prefer to retain, if possible, the supposed normal type, with a dash referring to a marginal explanation; also to retain the dash in cases where some unknown substitutional variation may be presumed.

Some vigorous effort is needed to restrain the amazing fecundity by which the multiplication of types and hard names have become a pest to the science.

				Sources.	Acid.		Base.	
1. Acetic Ether	C_8	H_8	O_4	—	Acetic acid	$HO+C_4H_3O_3$	+ Alcohol	$C_4H_6O_2$ — 2HO
2. Stearine	42	42	8	Animal fats	Stearic acid	$HO+36\ 35\ 3$	+ Glycerine	$6\ 8\ 6$ — 2HO
" Bi "	78	76	9	" "	" "	$HO+72\ 69\ 5$	+ "	$6\ 8\ 6$ — 4HO
4. Tri "	114	110	12	" "	" "	$HO+138\ 103\ 7$	+ "	$6\ 8\ 6$ — 6HO
5. Salicine	28	18	14	Willow bark	Saliginine	$HO+14\ 7\ 3$	+ Sugar	$12\ 14\ 14$ — 4HO
6. Populine	40	22	16	Aspen bark	—	$HO+28\ 11\ 5$	+ "	" " " — 4HO
7. Phloridzine	42	24	20	Cherry bark	Phloretine	$HO+30\ 13\ 9$	+ "	" — 4HO
8. Quercitrine	38	18	20	Quercitron bark	—	$HO+24\ 7\ 9$	+ "	" — 4HO
9. Esculine	42	24	26	Horsechesnut	Esculetine	$HO+18\ 5\ 7$	+ 2 Sugar	2(") —10HO
10. Paviine		—		Ash bark	—	— —	+ Sugar	" —
11. Saponine		—		Soap wort	—	— —	+ "	" —
12. Frangulin	40	20	20	—	—	$HO+28\ 9\ 9$	+ —	— — 4HO
13. Plobaphen	52	24	28	—	Oak red	— —	—	— —
14. Caincin	48	39	21	Chiococca Ramosa	Chiococcin	$HO+36\ 27\ 9$	—	— — 2HO
15. Amygdalin		—		—	—	— —	—	— —
16. Rubian		—		Madder root	Alizarin?	— —	+ Sugar	— —
17. Indican		—		"Indigofera"	Indigo red?	— —	+ "	— —
18. Antiarine		—		"Antiaris"	Yellow resin	— —	+ "	— —
19. Murrayin	72	44	40	—	Murrayetin	$HO+48\ 23\ 19$	+ 2 Sugar	2(12 12 12) — 4HO

2 and 3.—It remains to be seen whether these substitutions take place in the acid or in the base—precedents are equally available for both cases; and this alternative applies to the whole series. The StO_3 of No. 3 would be—

$$\overbrace{C_{36}H_{34}(C_{36}H_{35}O_2)O_3},$$

that of No. 4 would be—

$$C_{36}H_{33}(C_{36}H_{35}O_2)_2O_3.$$

6.—The acid, 28 11 5, easily splits into benzoic acid, whence it may be that this acid is of type No. 5, with the radical of benzoic acid (14 5 2) replacing 1H.

7.—The acid, 30 13 9, splits into phloretic acid, $HO+18\ 9\ 5$, whence it may be that acid with 1 (12 5 4) replacing 1H. Phloridzine gives a characteristic ammonia phloridzeine, just as orcine gives a similar ammonia orceine; and I subsequently find orcine is associated with a lichen sugar!

18.—Antiarine is—C, 61·2; H, 8·1; O, 30·7. Its yellow resin is—C, 83·9; H, 9; O, 4·2.

These studies have afforded much pleasure in the prosecution; but, while our leading chemists are eagerly pursuing other routes, they are presented with diffidence and humility, in the hope that other minds may be induced to take stock of progress, and to enquire whither we are tending, and what are the materials elaborating in our workshops or laboratories for the popularisation of science.

PRELIMINARY NOTE ON NAMAQUALITE.

BY A. H. CHURCH, M.A.

Some time ago I obtained from Mr. J. R. Gregory a few pieces of a beautiful blue silky mineral which he had obtained during his recent visit to South Africa, from one of the copper miners of Namaqualand. The qualitative examination of the mineral proved it to contain copper, aluminium, and water, with traces of calcium, magnesium, and iron. Several specimens were crushed into fragments, and the pure homogeneous parts picked out for quantitative analysis. The percentage numbers correspond pretty closely with the formula $Al_2H_6O_6$, $3CuH_2O_2,4aq$.

The constitution of this mineral appears to warrant the bestowal of a specific name; the locality of its occurrence suggests that of *Namaqualite*. I am engaged in completing the investigation of the physical and chemical characters of this compound; but I may now mention that it occurs in thin layers made up of short silky fibres, and is of a pale blue colour. The layers alternate with another copper mineral, which is amorphous, and is probably chrysocolla. Namaqualite has something of the aspect and texture of a soft variety of crocidolite or of chrysotile. The absence of silica from namaqualite is remarkable. As far as at present made out, it would seem to be a cupric aluminic hydrate, hitherto unrecognised.

ON SOME MEANS FOR

PREVENTING THE BUMPING OF BOILING LIQUIDS.

BY HUGO MÜLLER, F.R.S.

The annoyance which arises from the bumping of certain liquids when submitted to distillation or boiling has often attracted the attention of chemists, and various means have been proposed for its prevention.

The value of pieces of platinum, charcoal, burnt clay, and other porous bodies for this purpose is well known, and, under certain circumstances, are efficient enough; yet there occur very frequently cases in the laboratory when these means are unavailable.

About two years ago Pietro Pellogio (*Fresenius, Zeitschr.*, vi. Jahrg.) proposed a very simple contrivance, which was stated to act very satisfactorily indeed. It consisted of a moderately wide glass tube, passing through the cork of the tubular of the retort, and nearly reaching the bottom of it, the upper end being bent at right angles and drawn out into a capillary tube.

Having occasion to try the efficiency of this arrangement, I came to the conclusion that it was quite inef-

fective, and shortly after, G. Hager (*Pharmac. Centralhalle*, Bd. 9) confirmed the negative results I obtained.

Quite recently E. Winkelhofer (*Ber. d. Chem. Gesellsch. Berlin*, p. 194, 1869) proposed for the same purpose the application of an electric current, which, through the incipient decomposition of the liquid and consequent evolution of gas, causes the ebullition to become quite regular and steady. Dufour, for another, with another object in view, had made use of the same means.

The application of the electric current unfortunately presupposes that the liquid to be distilled is a sufficiently good conductor of electricity; and, if this is not the case, necessitates the introduction of such substances as shall cause the liquid to become a conductor. This circumstance, therefore, limits very considerably the use of this otherwise efficient arrangement, and it is on this account that I venture to bring under notice some other means which I have tested in a variety of cases, and which invariably proved satisfactory.

In cases where the introduction of any foreign matter into the liquid about to be distilled is undesirable, I introduce through the cork in the tubular of the retort a glass tube, which is drawn out to a long capillary tube and pressed tightly to the bottom of the retort. The upper end of the glass tube is connected, by means of an india-rubber tube, with a generator of carbonic acid, or hydrogen, or a gas-holder containing air, and whilst the distillation is going on, one of these gases is passed in a slow but continuous current through the liquid. Under these conditions, all bumping is avoided, and the distillation proceeds with the utmost facility.

For ordinary purposes, however, I have found it still more convenient to introduce into the liquid about to be distilled a small fragment of sodium amalgam, or, in cases where the liquid is acid, a small piece of sodium-tin. Methylic alcohol is well known to be one of the most difficult liquids to distil, yet, on the introduction of a minute piece of sodium amalgam, or sodium-tin, it can be distilled without the slightest inconvenience. I found on one occasion that more than 400 grammes of methylic alcohol distilled over with perfect steadiness, and without exhausting the activity of a fragment of sodium-tin, weighing not more than 0·060 grms.

It is, perhaps, hardly necessary to mention that the action of sodium amalgam and sodium-tin is due to a minute but continuous disengagement of hydrogen taking place during the process of distillation.

UTILISATION OF BLAST FURNACE SLAG.*

In this paper the author endeavours to point out some of the uses to which this almost valueless material, which is produced in very large quantity in the manufacture of iron, may be applied. He states that slag is a compound containing an excess of lime, and produced by the siliceous and earthy matters contained in the iron-stone, combining with the lime of the limestone used as a flux. Grey slag contains, in 100 parts:—Silica, 38·25; alumina, 22·19; lime, 31·56; magnesia, 4·14; protoxide of iron, 1·09; manganese, a trace; sulphide of calcium, 2·95; but the composition of slag differs according to a variety of circumstances.

The author then discusses the means of converting slag into paving stones, applying it to the manufacture of sulphate of alumina, aluminate of soda, and pure silica for the manufacture of porcelain, for most of which purposes patents have been taken out. He then proceeds to point out a plan of his own invention in which the slag, after being brought into a suitable state of subdivision, is treated with hydrochloric acid, whereby silica is obtained in a gelatinous form, and the alumina, lime, magnesia, and iron dissolved; the solution is evaporated to dryness, washed with water to dissolve out the soluble salts, the insoluble residue is treated with sulphuric acid, by which means sulphate of alumina is formed, the solution of which may be decanted off; the silica after washing with water is left in a pure state. The sulphate of alumina may either be evaporated to obtain that salt in the solid and dry state, or it may be used for the manufacture of alum. By this process slag will give a product worth £3 per ton and another worth £7 per ton. The author uses hydrochloric instead of sulphuric acid, as it is, in many instances, a waste product. Every 100 tons of slag will yield 33 tons of silica and 147 tons of sulphate of alumina.

* Abstract of a paper read before the Cleveland Institution of Engineers, by Mr. Crossley.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

July 1st, 1869.

Dr. A. W. Williamson, F.R.S., President, in the Chair.

The minutes of the preceding meeting were read and confirmed.

The President stated that, as the meeting was an extraordinary one, the routine business would be dispensed with.

A written communication from Dr. Mills, on the subject of "*The Atomic Theory*," was read. No discussion followed, but the President said he should feel honoured if, after seeing in print what he himself had put together on the subject, they thought it worth while to go into the question some evening.

A paper by Mr. H. Smith, F.C.S., "*On Ethyl Hyposulphurous Acid*," was then read.

The author prepared ethylic sulphide by placing protosulphide of potassium in a retort with ordinary alcohol, passing the vapour of ethylic chloride into the liquid, and then applying heat, when a distillate, containing ethylic sulphide, alcohol, and ethylic chloride, came over. Water was added, and the oil which separated re-distilled. After rectification with calcium chloride, it had a constant boiling point at 81° C.

Ethylic sulphide was treated with an equal bulk of strong sulphuric acid, a large quantity of water added, and the whole neutralised with pure barium carbonate, the resulting solution of barium ethy-hyposulphite evaporated to one-third of its bulk, and set aside to crystallise. The author has also prepared the copper, silver, and sodium salts.

The President remarked that, according to the formula given by Mr. Smith, half of the metal of ordinary hyposulphites was replaced by ethyl, and it was merely analogous in its constitution to a sulphate. It did not, as far as he could see, bear in any direct way on the question of the constitution of the hyposulphites, which occupied their attention a few meetings since.

Mr. Perkin wrote the following formula on the board:—Barium salt—$(C_2H_5)_2BaS_1O_4+2H_2O$. The sodium salt would, therefore, be:—$C_2H_5NaS_2O_3+H_2O$.

The President remarked that the constitutional water was still undisturbed.

A paper by Dr. Phipson, "*On the Absorption Spectra of Certain Organic Substances*," was then read. The author had found that cyanine gave an absorption spectra resem-

bling that of mauve. He also found that the colours of certain flowers gave absorption bands in the spectrum.

Mr. McLeod then explained "*An Apparatus for the Determination of Gases Dissolved in Natural Waters.*" The water is measured in a graduated pipette into which it is introduced without coming in contact with air, mercury being drawn from the bottom of the pipette, while a narrow tube connected with the upper part of the measure is passed to the bottom of the bottle containing the water. The water is then allowed to flow into the lower of two globes connected by a narrow glass tube, and in which a Torricellian vacuum has been produced. The lower globe stands in a water-bath heated to 50°, and the water is allowed to remain at that temperature for about 30 minutes. During this time almost the whole quantities of the nitrogen and oxygen dissolved in the water are evolved together with some carbonic anhydride. Mercury is then allowed to rise from a reservoir into the bulbs, and the gas, which has been evolved, removed by means of a Sprengel's mercurial pump, through a stop-cock at the top of the upper globe. After this, the mercury is run out from the globes and the water-bath more strongly heated, a slow current of cold water being allowed to trickle over the upper bulb. By this means the water is distilled *in vacuo*, and the gases remaining, which consist almost exclusively of carbonic anhydride, are eliminated from the water. These gases are then removed, as before, from the apparatus, by means of the Sprengel and analysed.

It was found necessary to resort to the process of distillation in order to decompose the soluble acid calcic carbonate; as some of this compound remained unaltered, even when maintained for two hours at a temperature of 105°—109° in a salt-water bath. The following results were obtained from 100 c.c. of a sample of tap water drawn from the cistern of the Royal College of Chemistry.

I.

	Gas evolved at 50°. c.c.	Gas evolved on distillation. c.c.	Total. c.c.
N	1·3906	0·0067	1·3973
O	0·6093	0·0113	0·6206
CO_2	0·4199	3·8769	4·2968
	2·4198	3·8949	6·3147

II.

	Gas evolved at 50°. c.c.	Gas evolved on distillation. c.c.	Total. c c.
N	1·3956	0·0022	1·3978
O	0·6057	0·0135	0·6192
CO_2	0·4990	3·6809	4·1799
	2·5003	3·6966	6·1969

The mercurial pump employed in these experiments is slightly modified from that originally described by Dr. Sprengel, in the *Journal of the Chemical Society*, though in the three experiments which have been tried, the results have not nearly equalled those described in his paper. Dr. Sprengel obtained a residue of air in an exhausted receiver equal to 1-1,300,000th of the original quantity: the best result obtained in the above-mentioned experiments being only 1-516,666th. By means of this apparatus, however, Dr. Frankland and Mr. Lockyer have rarefied perfectly dry oxygen, nitrogen, and hydrogen to such an extent, that their resistance was equal to that of atmospheric air at the ordinary pressure. The quantity of carbonic anhydride in carbonates may be determined in the form of gas, as first suggested by Dr. Russell, the Sprengel being employed for removing the gas from the valve in which the carbonates are decomposed. For this purpose a weighed quantity of the carbonate is placed in a small glass tube, which is then introduced into a wide perpendicular tube about 900 m.m. in length, and provided with a stop-cock at the upper end. The lower orifice is placed under mercury, and the air removed by means of the Sprengel. Dilute sulphuric or hydrochloric acid is passed up the tube, and the carbonic anhydride which is evolved removed and measured. In two experiments, the quantities of carbonic anhydride evolved from white marble were 43·72 and 43·61 per cent.

"*A New Form of Apparatus for Gas Analysis.*"—This is a modification of the apparatus described some years ago by Dr. Frankland and Mr. Ward. It consists of two tubes, one about 5 and the other about 20 m.m. in diameter. These tubes are, respectively 1,100 and 900 m.m. long. They are surrounded by a cylinder, through which a constant stream of water flows, and communicate with one another, just below the wide cylinder, by means of a caoutchouc joint surrounded by calico. The lower end of the narrow tube is also connected, in a similar manner, with a tube provided with a stop-cock, and which descends 900 m.m. below the joint, and communicates, by means of a long flexible tube surrounded with calico, to a reservoir containing mercury, which is so suspended that it can be raised above the level of the top of the apparatus. The narrower tube is graduated in millimetres from the bottom to the top, the upper end being closed by a glass stop-cock. The wide tube is marked with divisions at every 100 m.m., the contents of each division being determined. This tube is provided with wires, and closed at the upper end by a capillary tube and glass stop-cock, with a steel cap, by means of which it may be attached to a short and wide laboratory tube, such as is used in the apparatus described by Dr. Frankland in the *Journal of the Chemical Society*, 2nd series, vol. vi., p. 109. The analysis of gases is performed with this apparatus in the same manner as with the original one of Frankland and Ward, the measurements being made by determining the temperature and tension of fixed volumes of gas. The absorptions are performed in the laboratory tube, and explosions in the measuring tube. The whole apparatus may be easily worked with 900 c.c. of mercury, and the results obtained are very satisfactory.

Dr. Russell read a paper entitled "*Further Experiments on the Atomic Weights of Cobalt and Nickel.*"

In 1863, the author published an account of researches on the determination of the atomic weights of cobalt and nickel by the reduction of the oxide by hydrogen, when he found the atomic weights of cobalt and nickel to be 29·37. Since then, experiments had been made by two other chemists, Sommannga and Winkler, the former of whom gave 29·99 for the atomic weight of cobalt, and 29·01 for nickel, while Winkler's determinations showed cobalt to be 29·49, and nickel, 29·53. More recently, Dr. Schneider, in a paper to *Poggendorff's Annalen*, called attention to the fact that Sommannga's determination of the atomic weights almost coincided with the numbers he had previously obtained, and endeavoured to explain why Dr. Russell's numbers differed from his own. The author had lately experimented with the same cobalt and nickel used before, and determined the atomic weights from the volume of hydrogen evolved when a known weight of the metal was dissolved in hydrochloric acid, and the results fully confirmed the accuracy of his former experiments. The mean of four experiments by the reduction of the oxides determined the atomic weights of both nickel and cobalt to be 29·37; the mean of four experiments from the volume of hydrogen evolved was 29·38 for each metal.

The President thought it a most admirable confirmation of the conclusion arrived at by different methods, that numbers so very nearly coincident with these should be obtained by this process, and it was satisfactory that the result was established by concurrent evidence of very different kinds.

Professor Wanklyn said that the experiments related by Dr. Russell were particularly interesting to him, as they confirmed the views expressed by himself and Mr. Chapman about the hydrogen process.

After a verbal communication "*On the Action of Phosphoric Chloride on Oil of Vitriol*," by the Rev. Mr. Williams, the meeting was adjourned till the next session.

QUEKETT MICROSCOPICAL CLUB.

The fourth annual general meeting was held on Friday evening last, in the library of University College. Mr. Arthur E. Durham, President, in the chair.

A report was read, which showed that 142 members had been elected since the last annual meeting, making a total of 512. The Treasurer's report showed that the finances were in a very satisfactory condition.

In vacating the chair which he had filled for two years the President delivered a highly impressive address, which was listened to with marked attention throughout.

The following gentlemen were elected to fill the offices named for the ensuing year:—

President—Mr. P. Le Neve Foster.

Vice-Presidents—Dr. R. Braithwaite, Mr. W. M. Bywater, Mr. E. A. Durham, Mr. H. F. Hailes.

Members of Committee—Mr. T. Crooke, Mr. B. T. Lowne, Mr. S. J. McIntire, Dr. J. Matthews.

Treasurer—Mr. R. Hardwicke.

Hon. Secretary—Mr. T. Charters White.

Hon. Secretary for Foreign Correspondence—Mr. M. C. Cooke.

A paper "*On the Ratio Micro Polariscope*," by Mr. James J. Field, its inventor, was read, at the conclusion of which the instrument was exhibited. Ten new members were elected, after which the proceedings terminated.

NOTICES OF BOOKS.

Laboratory Teaching; or Progressive Exercises in Practical Chemistry. By C. L. Bloxam. John Churchill and Sons. 1869.

We can scarcely imagine a man more competent to treat of laboratory teaching than Mr. Bloxam. Commencing his studies at the College of Chemistry, he soon became the first assistant there, and the work which he then brought out in conjunction with Mr. Abel has long been familiar to the student of practical chemistry; altogether, for no less than twenty-three years, has Mr. Bloxam been a teacher of laboratory practice; hence we have before us no imaginative system, elaborated in the mind but unpractised in the laboratory, but a system of instruction based on—nay, entirely made up of—experience. And it is not alone the most efficacious mode of teaching practical chemistry which must result from lengthy experience, but an exact and elegant manipulative skill; and an ingenuity in devising processes and experiments are alone attainable by this means.

The work before us is quite devoid of any theory; there is not a formula or a symbol in the whole book; it is essentially a treatise on *practical* chemistry. It contains in the words of the author—

(1.) "A series of simple tables for the analysis of unknown substances of all kinds (not excepting organic bodies) which are known to be single substances, and not mixtures.

(2.) "A brief description of all the practically important single substances likely to be met with in ordinary analysis, by which the learner may satisfy himself that his results are correct, and may, at the same time, become acquainted with the leading properties of the most important chemicals, and with the foreign substances which they are liable to contain

(3.) "Simple directions and illustrations relating to chemical manipulation, not collected into a separate chapter, but given just where the learner requires them in the course of analysis.

(4.) "A system of tables for the detection of unknown substances with the aid of the blowpipe.

(5.) "Short instructions upon the purchase and preparation of the tests, intended for those who have not access to a laboratory."

Mr. Bloxam describes the various processes of chemical manipulation with an extreme minuteness of detail, and always effects his object by the simplest means; thus he says, "When a mortar is not at hand, substances of moderate hardness may be powdered on a hard surface by rolling a bottle over them;" a piece of broken porcelain may be often substituted for platinum foil; and Bunsen's burners may be improvised by placing a funnel over and a little distance above an ordinary gas-burner. We think, however, that a crudity of operation, although safe in the hands of a careful and accomplished chemist like Mr. Bloxam, may lead to carelessness and a want of delicacy and cleanliness in the student; it may lead him to regard processes which require the utmost skill as more or less rough operations, in which a large margin may be left for error of action. To our mind, we cannot have too elaborate or perfect apparatus for our infinitely delicate chemical operations: we cannot warn the student too often against inattention to minute points of cleanliness in his operations; we cannot too often impress upon him the necessity of rendering assurance doubly sure—the double rinsing of his cleaned (and nominally clean) test-tubes, and other vessels, the examination of the purity of his tests, the infinite solicitude which he must give to his boiling liquid, or his filtering solution, lest one small drop—be it but so much as makes "the twentieth part of one poor scruple"—be lost; and, although in qualitative analysis the need for extreme caution is to some extent removed, we must remember that a careless habit once acquired is not relinquished when the student passes to quantitative analysis. We were in a laboratory the other day which, for neatness and cleanliness, not to say primness, might vie with a Quaker's drawing-room; not a speck of dust was visible, not a bottle had dirty streaks of its contents coursing down its sides to deposit themselves on the shelf beneath; there was no confusion, and the air was as fresh as it ever can be in London; the usual dirty benches were replaced by clean slabs of plate-glass, whitened beneath, and everything was trim and smart. Yet this was not one of the laboratories of the *dilettanti;* there was plenty of good hard work going on in it; and, with a little management, all laboratories might be equally clean.

Mr. Bloxam has introduced a number of extremely useful tables into his work, to indicate the mode of detecting various elements and compounds; these tables are explained in the text, and constant back-reference is given to them and to individual paragraphs, which latter are distinguished by thick-letter numbers. Not only do we find the modes of detecting the simpler substances, but a large number of organic bodies are also introduced, together with the means of their identification; thus we find picric acid, cholesterine, acetone, naphthaline, aniline, and many other organic bodies described. Altogether, the work is most comprehensive; a great deal could be done with it; a chemist cast upon a desert island with it, and a box of reagents, could examine with ease all the principal products of the place, both mineral and vegetable. To the mining chemist, the work will be of much service; indeed, its usefulness is by no means confined to the student; we venture to assert that the book will be found useful in every laboratory as a work of quick reference and concise direction.

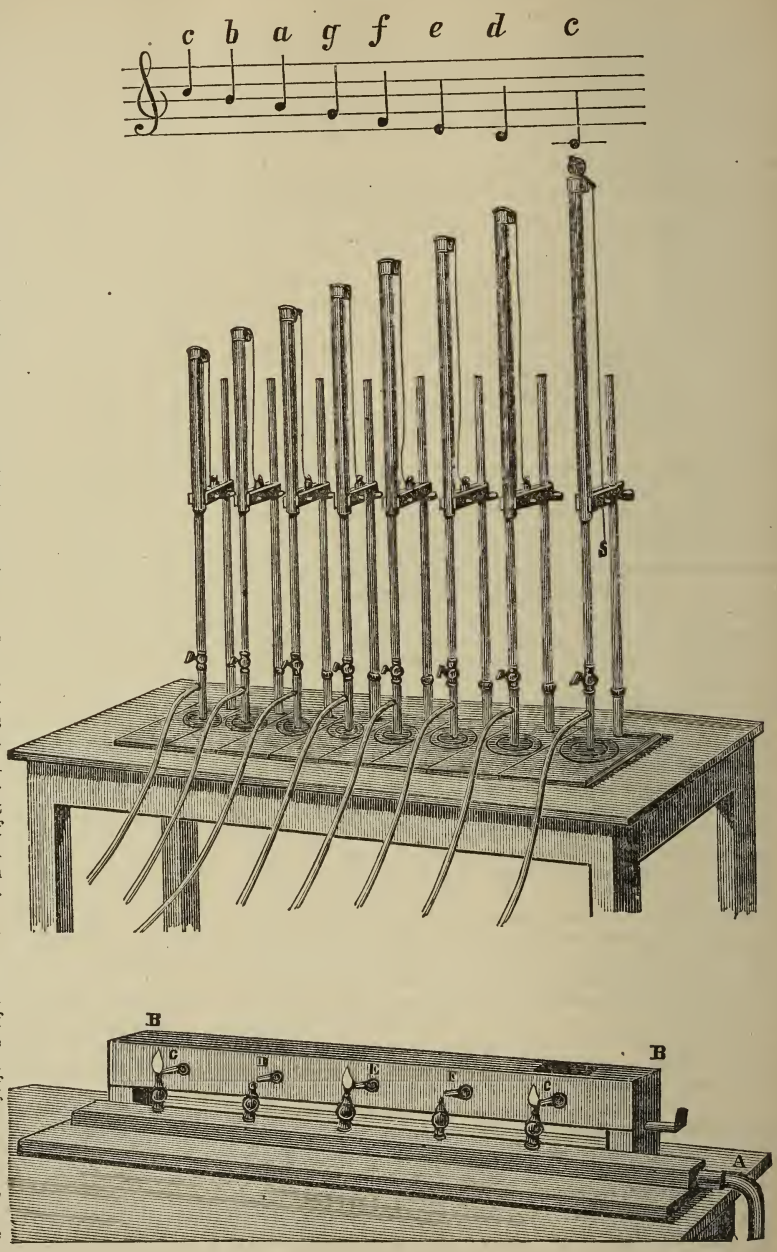
Mr. Bloxam is a thorough conservative; we imagine he is the General Peel of his party—a thoroughly conscientious, sound, true old tory, just a thought obstinate, but with the firmest convictions. It will be remembered that, in his "Chemistry Inorganic and Organic," he has not adopted the new nomenclature or the new equivalents; and we observe here that he has introduced such words as "white vitriol," "zinc-white," "Glauber's salt," and "Scheele's green." An air of conservatism pervades the whole work, yet we do not intend to deprecate this, but are rather of opinion that it may help to check the rapidly-advancing tide of chemical radicalism.

Cyclopædic Science Simplified. By J. H. Pepper. London: Frederick Warne and Co. New York: Scribner, Welford, and Co. 1869.

Of a verity this book is a small cyclopædia of science; the variety of subject-matter is astonishing, and six hundred wood-cuts lend their aid to the simplification. Within the memory of most of us the only source of very popular science for boys was to be found in the "Boy's Own Book," where science was bounded on the right by perhaps Cricket, and on the left by Boating, and the dominant experiment was the "Lead tree," while examples of chemical combination were ordered to be made somewhat after this fashion:—"Take a sixpence, put it in a small tea-cup, and pour upon it about a wine-glass full of aqua fortis; it will immediately dissolve; now add a pinch of salt, and the silver will fall down as a white powder," and so on. Now, for having led boys from such science as this, and given them sound science resulting from the labours of sound men, and often accompanied by their own explanations, we think every school-boy ought to thank Mr. Pepper. He cannot open this book without having his mind simultaneously opened, and it is his own fault if he ever closes it again.

As for subject matter, we have light, heat, electricity, magnetism, pneumatics, acoustics, and chemistry. In the article on Light, a detailed account, accompanied by woodcuts, is given of the celebrated ghost delusion, which surprised us all so much a few years ago, and of which M. Marion has given such a capital account in his *Merveilles de l'Optique*, one of that admirable series well called 'Bibliothèque des Merveilles," from whatever point of view we may consider it.

If we specialize at all we may perhaps mention the chapter on Acoustics as being well illustrated. The accompanying figure represents the "gas flame organ," by means of which, we are told, simple tunes have been played; while in the second figure, we have the apparatus of Pichler for showing the position of the nodal points and ventral segments in a vibrating column of air. When the column of air in the tube, B B, is caused to vibrate, the gas jets, D and F, which are opposite to the centres of ventral segments, are blown out, while the jets, C, E, G, remain lighted, because they are opposite to nodal points—that is, points where the column of air is at rest.



Mr. Pepper also tells us lots of scientific "dodges," explains the talking head of Albertus Magnus, and indicates the true position of the "invisible girl," who, being in communication with "a sort of ornamental bedstead," yet all unseen, answers any questions addressed in the neighbourhood thereof. But there is much severer science than this; we would refer to the accounts of magnetism and dia-magnetism specially, also to the account of the Atlantic cable; in fact, we recommend all young fellows with any glimmer of a taste for science, to take the book home with them at the approaching summer holidays, to read it carefully, and, as far as is possible, experimentalize for themselves.

Sound: A Course of Eight Lectures delivered at the Royal Institution of Great Britain. By John Tyndall, F.R.S. Second Edition. London: Longmans, Green, and Co., 1869.

Dr. Tyndall has proposed to himself to publish a series of works on Natural Philosophy, suited not only to the requirements of the students, but, as far as is practicable, to the popular ear. They are to have as their bases, the lectures which he is in the habit of giving, year by year, at the Royal Institution, and already two such handbooks have

appeared—the well-known treatise "On Heat Considered as a Mode of Motion," and the treatise "On Sound," the second edition of which we have before us. The value of these works is too well known to the scientific to need any mention here. They form the most complete separate works on the several subjects of which they treat to be found in this language, and Dr. Tyndall is careful to introduce the most recent researches of continental philosophers, many of which are not readily accessible to the English public.

In comparing our scientific works with those of France and Germany, there are, however, several most notable differences; differences which rest with the publisher rather than the author, and until these be overcome we cannot have any great diffusion of standard scientific works in this country. We allude chiefly to the great expense of our works on science, and the above are no exception to the rule. Let any of our readers look at the volumes of the admirable *Bibliothèque des Merveilles* at 2 francs the volume, and ask himself what would be their price in this country—certainly seven shillings and sixpence. They are by eminent men, are well printed, and well illustrated, and such a series would be a great boon to this country. As to woodcuts, they, for the most part, excel those of our best works on science, into which we rarely introduce copper or steel plates, and coloured engravings less rarely still.

The second edition of Tyndall "On Sound" differs but slightly from the first; the main difference is the addition of an appendix of 9 pages, containing an account of the recent researches of M. Regnault on the propagation of sound, written by himself. Many of our readers have heard Dr. Tyndall's lectures on sound, and will remember how well they were illustrated, specially as regards the production of Lissajous' figures, drawings of many of which are given.

The first lecture treats of the production and propagation of sonorous waves through various media. The second distinguishes between noise and music, musical pitch is defined, and a good account of the admirable "double syren" of Helmholtz (from his "*Die Lehre von den Tonempfindungen*,") is given. In the third lecture is discussed the vibration of strings, the general nature of progressive and stationary waves, and the optical examination of the vibrations of a piano wire. Lecture 4.—The vibrations of rods, square plates, discs, and bells. Lecture 5.—The vibrations of columns of air in organ pipes, the human voice, and reed-pipes. Lecture 6.—Sounding flames which have of late engaged so much attention. Lecture 7.—The interference and coincidence of sonorous waves, and the theory of "beats." Lecture 8.—The conditions of musical consonance, the harmony of musical sounds, and the optical examination of musical intervals.

The work is well illustrated for an English scientific book, and the style is agreeable, yet the book is more for the student than for the general reader; nine out of ten well-educated persons unacquainted with science could not comprehend many of the subjects discussed without reference to other works bearing on the subject. As a handbook for the student of science it is a valuable contribution to our scientific literature.

Traité Elémentaire de Physique. Par A. Privat Deschanel, Ancien Professeur de Physique au Lycée Louis-le-Grand. Paris: Hachette et Cie. 1869.

During the last few years, there has issued from the French press (and notably from the press of Messrs. Hachette) a series of beautifully-illustrated works, having for their object the popularisation of science. We need not do more than refer to "Le Ciel," and "Les Phénomènes de la Physique" of M. Guillemin, with their beautifully-coloured plates, their copper-plates, and their innumerable woodcuts. The recently-translated "Vie Souterraine" of M. Simonin is another example. In fact, the world has shown its appreciation of these works by the rapidity with which translations have been made into numerous languages. We saw the other day an "edition de luxe" of Guillemin's "Le Ciel" in Greek; and we should suppose that, by this time, it is to be found in Hindoostanee, perhaps in Chinese. There is no denying that we have no books among our native scientific literature which can compare with these: somehow our drawings of apparatus are heavy and cold, there is nothing artistic about them, and they are too often repellent to the eye, rather than attractive.

The book before us, although not belonging to the class of "Le Ciel," boasts three coloured plates, and 719 woodcuts in its thousand and eight pages. It is rather a student's manual than a popular work on physics. The subject matter is arranged in the following order:—Mechanics; Hydrostatics; Pneumatics; Hydraulics; Heat; Electricity; Acoustics; Optics. "Le traité," says M. Deschanel, "que je publie aujourd'hui est destiné à faciliter le travail des jeunes gens qui veulent obtenir ces grades" (universitaires), and, coming as it does from a man who, for nearly twenty years, was Professor of Physics in the Lycée Louis-le-Grand, it is a valuable contribution to French educational works.

Although by no means overloaded with mathematics, we are glad to observe the introduction of mathematical formulæ, wherever it is possible, without adding a great complexity to the matter discussed.

In the "Pneumatics," we notice an account of M. Kravogl's mercury air-pump, also of that of Geissler, but we seek in vain for mention of the admirable Sprengel pump.

The chapters on Heat are good, and are clearly written, but we think an insufficient mention has been made of Tyndall's experiments on the absorption and radiation of heat by gases, while the space devoted to the mechanical theory of heat is undeniably too short.

A good account, accompanied by a capital drawing, of the "machine à gaz" of MM. Otto and Lungen will be found on p. 306, and of the electrical machine of M. Holtz on p. 357. The subject of static electricity has been discussed with perhaps more diffuseness than any other subject. In dynamic electricity, we notice a very clear exposition of the actions of solenoids.

A chapter is devoted to the "Effets calorifiques produits par les courants," in which will be found a charmingly artistic drawing of the magnified "image des charbons" of the electric lamp; and, while we are on the subject of the woodcuts, let us mention No. 576 ("Propagation du son dans un milieu indefini") as singularly felicitous and elegant.

Of the book as a whole, we may say that we cordially recommend it to the student of science; he will find it clear and concise, abounding in good woodcuts, and remarkably moderate in price.

Qualitative Chemical Analysis. By Dr. C. Remigius Fresenius, Director of the Chemical Laboratory at Wiesbaden. Seventh edition. Edited by Arthur Vacher. London: John Churchill and Sons, 1869.

Many years ago, when analytical chemistry was but little studied in this country, and the few who practised it used Rose's "Handbuch der Analytischen Chemie," Mr. Lloyd Bullock introduced a translation of the works of Dr. Fresenius on "Qualitative and Quantitative Analysis." These are so well known to chemists, and have become such thoroughly standard authorities, that it is almost unnecessary to notice a new edition.

The "Qualitative Analysis," unlike the Quantitative, has diminished rather than increased in bulk, and this arises from an increased condensation and an alteration in some respects of the arrangement of the work. "This edition," says Mr. Vacher in the preface, "differs greatly from the last . . . The language has been condensed, the notation and nomenclature have been modernised, the arrangement has been simplified."

We are glad to notice the removal of the great mass of cross references, which formerly added so much to the already sufficient difficulties of the beginner, and which always

reminded us of one of the more complex pages of "Bradshaw."

The work, as now arranged, is divided into the following sections:—1. Reagents, apparatus, and manipulation; 2. Reactions and separations; 3. General analysis; 4. Special analysis; 5. Reactions and separation of rare inorganic bodies; 6. Reactions and separation of organic bodies; 7. Detection of poisons in bodies, food, &c.; 8. Tables. The few tables which are given are eminently serviceable, and might, with advantage, be printed separately on calico for laboratory use. It is a grand mistake to print tables on paper which are to be used side by side with the test-tube rack, and to bind them up with a book; we all know how soon they become torn, and discoloured, and acid stained. Such tables, together with works on chemical manipulation, might with advantage be printed upon calico or vegetable parchment.

Every book which is meant for constant laboratory use should have a special binding, as durable as binding can be made, and, best of all, literal boards of thin oak. We have the misfortune to possess a copy of Regnault's "Cours de Chimie," bound elaborately in white vellum. An *edition de luxe* of a work on chemistry is a far more useless object than an *edition de luxe* of a treatise on the infinitesimal calculus, and may be classed with silver trowels, ivory croquet mallets, Louis Quatorze clocks, and other ornamental but useless—at least, unpractical—things. A certain great king, we are told, once presented a certain great chemist with a laboratory, in which every vessel was of platinum; this was a laboratory *de luxe;* give us good glass, say we, with a judicious sprinkling of the above precious metal, with homely porcelain and still homelier Stourbridge clay, and we leave kings' gifts to kings' chemists, albeit a little Royal patronage would not be unserviceable to our science.

To return to our book; we may observe that the "Qualitative Analysis" of Fresenius is not so much in vogue as his "Quantitative Analysis," and this arises from the fact that there have arisen in our native chemical literature—sparse though it be—various works on "Chemical Manipulation," and "Laboratory Practice;" again, many teachers adopt a special form of their own, based, perhaps, upon that of Fresenius, but differing in character and arrangement therefrom. Still it looks well to have a seventh edition of any work on chemistry in this country, and we wish Messrs. Bullock and Vacher further success. We would suggest in conclusion that the utterly inadequate index of *less than two pages* should at least be trebled in size in the next edition.

Dictionnaire de Chimie Pure et Appliquée. Par Ad. Wurtz. Paris: L. Hachette.

The first *fascicule* of this work gives us some idea of its ultimate extent: although printed in somewhat small type, and in double columns, the 160 pages carry us only as far as Allyle. We shall review the whole work at length when it appears in its entirety, meanwhile, we propose rather to call attention to its general character than to give a review. M. Wurtz is assisted in his labours by no less than seventeen *collaborateurs*, among whom we notice the names of Debray, Emile Kopp, Lauth, and Naquet. The subject matter includes—Inorganic and Organic Chemistry; Chemistry applied to the Arts, Manufactures, and to Agriculture; Analytical Chemistry, and "La Chimie Physique et la Minéralogie."

We notice in this number an admirable article by M. Salet on "Affinity," terminated by a list of works relating to the subject which commences with the *Pyrosophia* of Barchusen (1698). We almost think that such a list is incomplete without the *Physica Subterranea* of Beecher, the *Tractatus Quinque Medico Physici* of Mayow, and the *Fundamenta Chemiæ* of Stahl, but it must be allowed that the idea of affinity possessed by these men was excessively crude and indefinite. Perhaps Otto Tachenius may also be quoted as having a glimmer of the action of predisposing affinity. The article on "Air" by M. Le Blanc is unfortunately short, and does not make mention of the more recent researches on impure and vitiated air. M. Caventon supplies an article on "Alkaloids," and he herein furnishes a very complete list of these bodies, including some which can scarcely be called familiar; for instance, Chiococcine (*Chiococca racemosa*); Ménispermine (*Menispermum cocculus*); and Surinamine (*Geoffræa Surinamensis*). In a somewhat elaborate article on "Alcohols" by Kopp, a very good description (accompanied by woodcuts) is given of the various stills which are used in the process of manufacture, among them the ingenious *appareil Champonnois*. We shall return to this work on its completion; meanwhile, we have no doubt that it will be found in every chemical library.

LABORATORY NOTES.

ACTION OF SODIUM ON WATER AND NITRIC ACID.

I send a few facts which you may perhaps consider worth a place in some corner of the Chemical News

When sodium is thrown upon water, the hydrogen does not kindle, as we all well know, unless the water be warmed, or the metal confined to one spot by blotting-paper. If sodium, however, be dropped upon nitric acid of specific gravity 1·36 (ordinary commercial), the hydrogen burns with ease; but if the acid be diluted this result ceases. I thought it of interest to ascertain the point of dilution, which was conducted in the following way:—The concentrated acid, to the extent of 680 grains, was placed in a beaker, which again was placed in a vessel of water; a fragment of sodium of equal size was then added, the acid being diluted with 25 grains of water before each addition of sodium. The rise of temperature consequent upon this dilution (always two degrees) was allowed to fall back to that of 66° F., at which the experiments were commenced. Seventy-two experiments gave as the result, that the hydrogen ceased to kindle when the acid was diluted to specific gravity 1·056. The residue contained a fair amount of ammonia. I have used this dilute nitric acid with advantage, when showing the preparation of hydrogen by potassium and sodium as a lecture experiment, as the results then appear similar. No doubt the rapid oxidation of the sodium into nitrate is the explanation. I am, &c.,

Thomas Bloxam,
Lecturer on Chemical and Natural Philosophy,
Cheltenham College.

CORRESPONDENCE.

The Faraday Memorial.

To the Editor of the Chemical News.

Sir,—I read with regret that the proposed memorial to Faraday is to be in the form of a statue in St. Paul's Cathedral. I am very sorry to differ from those who, doubtless knowing Faraday better than I did, though they could not have loved him more, support this proposal. Government has refused to contribute anything to the memory of this great man, on the ground that he did not hold the position of a public servant. Had he been a fighting man, doubtless a statue would have been raised to his honour. But why should we attempt to rival Government in erecting a statue in a State church? Ought we not rather to make our memorial take a scientific and beneficent form, such as Faraday himself would have approved? England can do many things well, but she cannot make an artistic statue. Why, then, should we waste this splendid opportunity of doing good in the production of a wooden figure at great cost? And the good I would propose is the creation of a permanent fund for the encouragement of poor students in science, and poor investigators. Many would give—I for one—their five guineas to such a fund, who would withhold it if the money is to be spent on stone. There are poor boys in poor

schools who display an unusual amount of talent, but for want of means of patronage have no opportunity of rising. Could not such boys be collected in a Faraday college, and trained up in science? We might thus get the pick of undeveloped talent throughout these islands.

Faraday, who shunned empty titles, does not want a statue. His kindly feeling was always extended to workers in science. I have several times received a word of encouragement from him, either written or spoken, when it was most refreshing because most needed. I will mention an example of his self-denying kindness, which is not, I believe, known, although thousands of such cases might be collected, for no one came in contact with Faraday without receiving some benefit.

Mr. Weale, the publisher, told me that a scientific man, having agreed to write a book for him, delivered the copy and then had to go abroad. Mr. Weale read the proof-sheets. In one sheet several difficulties occurred which he could not solve. Not knowing who to apply to, he bethought himself of Faraday, although personally unknown to him. The messenger arrived at the Royal Institution, delivered the parcel, and said he would wait. "It is of no use," said the porter, "Mr. Faraday is unwell, and is ordered out of town; he is just going to start." While the messenger was remonstrating, Faraday appeared, carpet-bag in hand, took the packet, and read the letter. "Oh, yes," said he, "I will do this for Mr. Weale. I can go by the next train."

Can the memory of such a man be honoured by resorting to the worn-out custom of erecting an ugly statue?—I am, &c.,

F. R. S.

June 25th, 1869.

Superphosphates.

To the Editor of the Chemical News.

Sir,—I observe in the Chemical News of last week an inquiry regarding the possibility of distinguishing between mineral and bone phosphates in superphosphates. If your correspondent will take two samples, one of a bone-ash and the other a coprolite superphosphate, and precipitate the insoluble phosphate by ammonia, and burn the precipitates, he will see that there is such a marked difference in the appearance of the two as to render it very easy to distinguish the one from the other.

Should your correspondent desire it, I shall be most happy to give him any information I can on the subject.—I am, &c.,

Arthur E. Davies, Ph.D.

Analytical Laboratory,
St. Mary's Gate, Manchester,
June 30th, 1869.

Explosion of Nitroglycerine.

To the Editor of the Chemical News.

Sir,—The frightful explosion of three-quarters of a ton of nitroglycerine in Wales, last week, and the deplorable loss of life and injuries attending it, may probably lead to some consideration on the part of the authorities as to whether an explosive agent apparently so unsafe should be allowed to be imported, or even used, in this country, notwithstanding that it appears to be established, at least to the judgment of many competent authorities, that for blasting a certain class of rocks there is no other agent at once so cheap in proportion to power and so effectual as nitroglycerine. The explosion referred to does not appear to have been the result of any carelessness; the "oil" was packed in metal canisters, which were surrounded by sawdust, and no one who has experimented with nitroglycerine can well attribute the explosion to any concussion that could have been caused by the jolting of the waggon in which it was conveyed, over, even, a somewhat rough road. Must, then, this explosion be classed with that which took place in Australia when the oil was at rest in a cellar? It would seem so. But if so, no confidence can be felt in employing an agent which may go off at any time; and the risk to life and property incurred in using it, will overbalance any possible advantage to be derived from its economy and efficiency.

Yet it is stated that nitroglycerine is *safer* than gunpowder. It is certainly less liable to be exploded by fire, and to disrupt the slender link which retains its elements, subject to chemical force, and set its mechanical force at liberty, by concussion, needs that concussion be sudden and forcible. I believe that a bottle full of blasting oil may be dashed to the ground without much danger, yet a drop of it upon a stone may be exploded by a blow from a hammer. Now what can be the possible cause of such unexpected explosions as have taken place? I can see only two possible reasons—First, that the oil undergoes decomposition or chemical change under certain at present unknown conditions, of time, temperature, shaking, &c, which predispose it to undergo a complete and sudden decomposition from causes ordinarily inadequate; secondly, that the cases and bottles in which it is contained, being air-tight, are liable, from a very trifling escape of gas from the liquid, to arrive at a state of tension from which the passage to a sudden break is easy. But would the mere bursting open of a bottle or tin case produce concussion sufficient to determine an explosion of the oil, unless we suppose the latter to be altered in quality? I think it would. I have known a stout glass bottle, used in an ethyl experiment, to be shattered by slowly gathered internal pressure into *dust*, with a report like the firing of a pistol. In a close vessel, full, or very near full of the oil, not much gas relatively to the quantity of liquid need be evolved in order to induce such a degree of pressure as might cause explosive rupture of the vessel. If one vessel burst, the concussion would certainly explode also any that might be near.

If the true cause of these seemingly anomalous explosions is indicated above, the remedy is both simple and inexpensive. Let every vessel containing the oil have fitted to it a tube, with a capillary bore, such as a piece of thermometer tubing, one end of the tube entering the oil, the other exposed outside.

If the tube were enlarged below to make room for any expansion of the liquid by elevation of temperature, none could be forced out by that alone, and none could be spilt through the capillary orifice of the tube by inverting the vessel. With a little management in the arrangements, any overflow might be made certainly indicative of the formation of permanent gases, which would be a warning signal. This method might also be applied experimentally to determine the probability or otherwise of the suggestion I have made as to the cause that may have led to these fearful explosions.

Certainly, the time is come when science should, in the cause of the public safety, investigate the "why" and the means of prevention of such horrors as that of the late catastrophe.—I am, &c.,

E. S.

Ramsay, Isle of Man,
July 7, 1869.

The Chemical Section of the British Association: The Official Report.

To the Editor of the Chemical News.

Sir,—On comparing the official report of my paper entitled "Researches on the Ethers," with my paper as it appeared in the Chemical News some time ago, I was astonished to find striking differences between them.

In justice to you as well as to myself, I beg to state that the version which you have published is the authentic version, and that in the official one the alterations have been made without my knowledge. Possibly I may bring this matter before the Exeter meeting of the Association.—I am, &c.,

J. Alfred Wanklyn.

London Institution.

Oleographs.

To the Editor of the Chemical News.

Sir,—During some months past there have been sent to me various paragraphs from general and trade newspapers, prices current, penny magazines, &c., praising Dr. Moffat's oleographs as being valuable in the oil trade, to druggists, &c., and associating them with my name. I have this day seen a notice which states that Dr. Moffat's oleographs are based on the cohesion figures of Mr. Tomlinson, "published last year."

In the Chemical News for the 11th December last (vol. xviii., p. 284—*American Repr.*, *Feb.* 1869, *page* 94), I gave the history of my discovery, dating from 1861, and published in that year, and in your number for 29th January last (vol. xix., p. 59—*American Repr.*, *Mar.* 1869, *page* 157), I recorded my opinion of these oleographs. I stated that they are without distinctive characters, and are consequently valueless as oil-tests.

Unless Dr. Moffat has wonderfully improved on the specimens he sent to me I do not understand how he can sanction, or, at any rate, allow to pass uncontradicted, the puffing paragraphs to which I refer. I have not the means nor the inclination to get counter statements inserted in the journals referred to, but I do hope that after this second protest in your columns Dr. Moffat will use his influence to correct the misapprehension which must arise from such paragraphs.

The cohesion figures of liquids are in themselves oil-tests; but when transferred to paper, as in these oleographs, the resemblance between the figure of one oil and that of another is so close that they may be taken as identical, and they are, therefore, for practical purposes, useless, as friends of mine connected with the oil trade have proved.

While heartily wishing success to oleography, I cannot see much prospect of it in the present state of the art, and I am sure that Dr. Moffat would not wish to describe as a finished picture that which is only a rough, and by no means correct sketch.—I am, &c.,

C. Tomlinson.

Highgate, N., July 26th, 1869.

Gaseous Spectra.

To the Editor of the Chemical News.

Sir,—Our attention has been drawn to a letter from Mr. W. Huggins, in your impression of the 9th instant (*American Repr.*, *Sept.* 1869, *page* 164), stating that, in a recent note to the Royal Society (in which we announced that, by varying the conditions of pressure and temperature, we had reduced the spectrum of hydrogen, as seen in our instrument, to one line absolutely, and the spectrum of nitrogen to one line nearly), we did not notice similar observations of his own presented to the Royal Society in 1868. In reply, we beg to state—First, that we did notice Mr. Huggins's observations, and, secondly, that they were not similar to our own.

With regard to the first point. The account you were good enough to publish contained the following:—"The bearing of these latter observations on those made on the nebulæ by Mr. Huggins, Father Secchi, and Lord Rosse is as once obvious. The visibility of a single line of nitrogen has been taken by Mr. Huggins to indicate possibly—First, 'a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect;' and then, secondly, 'a power of extinction existing in cosmical space.'

"Our experiments on the gases themselves show not only that such assumptions are unnecessary, but that spectrum analysis here presents us with a means of largely increasing our knowledge of the physical constitution of these heavenly bodies."

We thus gave briefly the results of Mr. Huggins's enquiries, and references to where a complete account of his observations were to be found. This we considered to be sufficient, seeing that our communication was a preliminary note only. In the complete account of our researches to be subsequently presented to the Royal Society we shall, of course, dwell upon them at greater length.

With regard to the second point—the similarity of the observations. In 1864, Mr. Huggins first observed the spectrum of the nebulæ, and determined that one of the lines was coincident with one of the air lines due to nitrogen, the spark being taken close to the spectroscope. On this Mr. Huggins wrote:—"The speculation presents itself, whether the occurrence of this one line only in the nebulæ may not indicate a form of matter more elementary than nitrogen, and which our analysis has not yet enabled us to detect." Some time afterwards, Mr. Huggins, instead of taking the air spark close to the spectroscope, placed it outside the object glass of his telescope, and then only saw one line in the spectrum—the line in question. He next got similar results close to the spark by interposing a dark glass to cut off the light, still using the spark in air at the ordinary pressure, and remarked that it was "obvious" that the hydrogen spectrum would give similar results. Then, after stating "we cannot suppose that any lines have been extinguished by the effect of the *distance* of these objects from us," he refers to the possibility of a "power of extinction residing in cosmical space," and the hypothesis of the more simple form of nitrogen appears to be given up.

Now, with regard to our own observations, we have *not* taken the spark in air; we have *not* used a dark glass; we have *not* worked at atmospheric pressure; nor have we disturbed the normal distance of the experimental tube from the slit of our instrument until we had reduced the complicated spectrum of nitrogen to one bright line and three or four other extremely faint ones. Further, we have *not* rested content with any assumption with regard to hydrogen, nor have we regarded anything as obvious.

What we have done is to carefully watch both spectra changing as the pressure becomes less, trying the effect of increased and decreased temperature at every stage, under various conditions, which we shall state in our detailed paper.

It may be as well to refer, in conclusion, to Plücker's important work on nitrogen, which shows that, under certain conditions, the green line of nitrogen vanishes altogether from the spectrum. This fact alone shows at once the importance of our method of inquiry.—We are, &c.,

E. Frankland.
J. Norman Lockyer.

Royal College of Chemistry, Oxford Street,
July 23, 1869.

Gaseous Spectra.

To the Editor of the Chemical News.

Sir,—In the paper on "Researches on Gaseous Spectra in Relation to the Physical Constitution of the Sun, Stars, and Nebulæ," by Dr. Frankland and Mr. Lockyer, as reported by you, the authors do not notice similar observations which I presented to the Royal Society in April, 1868. I send you the following extracts from that paper, which is printed in the *Phil. Trans.* for 1868.—I am, &c.,

William Huggins.

"The following observations are suggestive in connection with the point under consideration. Electrodes of platinum were placed before the object-glass in the direction of a diameter, so that the spark was as nearly as possible before the centre of the lens. The spark was taken in air. I expected to find the spectrum faint, for the reasons which have been stated in a previous paragraph (the diminution of the brightness of the spark from the distance at which it is placed from the slit), but I was surprised to find that only one line was visible in the large spectroscope when adapted to the eye-end of the telescope. This line was the one which agrees in position with the line in the nebula, so that under these circumstances the spectrum of nitrogen appeared precisely similar to the spectra of those nebulæ, of which the

light is apparently monochromatic. This resemblance was made more complete by the faintness of the line; from which cause it appeared much narrower, and the separate existence of its two components could no longer be detected. When this line was observed simultaneously with that in the nebula, it was found to appear but a very little broader than that line. When the battery circuit was completed, the line from the spark coincided so accurately in position with the nebular line, that the effect to the eye was as if a sudden increase of brightness in the line of the nebula had taken place. In order to make this observation, and to compare the relative appearance of the lines, the telescope was moved so that the light from the nebula occupied the lower half only of the slit. The line of the spark was now seen to be a very little broader than the line of the nebula, and appeared as a continuation of it in an unbroken, straight line. These observations were repeated many times on several nights."—(P. 542.)

"The double line in the nitrogen-spectrum does not consist of sharply-defined lines, but each component is nebulous, and remains of a greater width than the image of the slit.* The breadth of these lines appears to be connected with the conditions of tension and of temperature of the gas. Plücker † states that when an induction-spark of great heating power is employed, the lines expand so as to unite and form an undivided band. Even when the duplicity exists, the eye ceases to have the power to distinguish the component lines, if the intensity of the light be greatly diminished.

"Though I have been unable to detect duplicity in the corresponding line in the nebula, it might possibly be found to be double if seen under more favourable conditions; I incline to the belief that it is not double. ‡

"In my tables of the lines of the air § I estimated the brightness of each of the components of the double line in the spectrum of nitrogen at 10, and the components of the double line next in brightness in the orange at 7 and 5, and those of a third double line on the less refrangible side of D at 6 and 4. It was with reference to these two double lines next in apparent brilliancy that I wrote, ‖ in speaking of the line in the nebula, 'If, however, this line were due to nitrogen, we ought to see other lines as well; for there are specially two strong double lines in the spectrum of nitrogen, one at least of which, if they existed in the light of the nebulæ, would be easily visible.'

"As the disappearance of the whole spectrum of nitrogen, with the exception of the one double line, was unexpected, though, indeed, in accordance with my previous estimations, I examined the spectrum of nitrogen with a spectroscope furnished with one prism, with a refracting angle of 60°, in which the whole of the spectrum from C to G is included in the field of view. I then moved between the eye and the little telescope of the spectroscope a wedge of neutral-tint glass, corrected for refraction by an inverted similar wedge of crown glass, and which I had found to be sensibly equal in absorbing power on the different parts of the visible spectrum. As the darker part of the wedge was brought before the eye, the two groups in the orange were quite extinguished, while the lines in the green still remained of considerable brightness. The line which under these circumstances remained longest visible next to the brightest line, was one more refrangible at 2669 of the scale of my map. This observation was made with a narrow slit. When the induction spark was looked at from a distance of some feet with a direct-vision prism held close to the eye, I was surprised to observe that the double line in the orange appeared to me to be the brightest in the spectrum, and when the neutral-tint wedge was interposed, this line in the orange remained alone visible, all the other lines being extinguished.

"When, however, in place of the simple prism a small direct-vision spectroscope provided with a slit was employed, I found it to be possible, by receding from the spark, to find a position in which the double line in the green, with which the line in the nebula coincides, was alone visible, and the spectrum of the spark in nitrogen resembled that of a monochromatic nebula.

"It is obvious that if the spectrum of hydrogen were reduced in intensity, the line in the blue, which corresponds to that in the nebula, would remain visible after the line in the red and the lines more refrangible than F had become too feeble to affect the eye.

"It therefore becomes a question of much interest whether the one, two, three, or four lines seen in the spectra of these nebulæ represent the whole of the light emitted by these bodies, or whether these lines are the strongest lines only of their spectra which, by reason of their greater intensity, have succeeded in reaching the earth. Since these nebulæ are bodies which have a sensible diameter, and in all probability present a continuous luminous surface, or nearly so, we cannot suppose that any lines have been extinguished by the effect of the distance of these objects from us.

"If we had evidence that the other lines which present themselves in the spectra of nitrogen and hydrogen were quenched on their way to us we should have to consider their disappearance as an indication of a power of extinction residing in cosmical space, similar to that which was suggested from theoretical considerations by Chéseaux, and was afterwards supported on other grounds by Olbers and the elder Struve. Further, as the lines which we see in the nebulæ are precisely those which experiment shows would longest resist extinction, at least so far as respects their power of producing an impression on our visual organs, we might conclude that this absorptive property of space is not *elective* in its action on light, but is of the character of a *general* absorption acting equally, or nearly so, on light of every degree of refrangibility. Whatever may be the true state of the case, the result of this re-examination of the spectrum of this nebula appears to give increased probability to the suggestion that followed from my former observations, namely, that the substances hydrogen and nitrogen are the principal constituents of the nebulæ of the class under consideration."—(Pp. 543—544.)

* Secchi states that with his direct spectroscope this line in the annular nebula in Lyra appears double. As the image of the nebula is viewed directly, after elongation by the cylindrical lens, and without a slit, it is probable that the two lines may correspond to the two sides of the elongated annulus of the nebula.

† *Philosophical Transactions*, 1863, p. 13.

‡ "On the Spectra of the Chemical Elements," *Philosophical Transactions*, 1864, p. 141.

§ Ibid.

‖ Ibid., p. 443.

MISCELLANEOUS.

Jargonium.—We learn from the *American Journal of Mining*, of June 12th, 1869, that, at a meeting of the Polytechnic Association of the American Institute, held on June 3rd, a note was read "*On Jargonium*," which referred to the exhibition of jargonia by Mr. Sorby at the *soirée* of the Royal Society, and also to the communication by Professor Church in the Chemical News for March 12th (*Amer. Repr., May*, 1869, *page* 231). After the reading of the note, Dr. Isidor Walz spoke as follows:—"It will be remembered that, at a meeting of the New York Lyceum of Natural History, Professor Loew announced the discovery of Jargonium before the number of the Chemical News which contained an account of Mr. Sorby's discovery had reached this country. The discovery was, undoubtedly, made by the English and American discoverers quite independently of each other."

Endowment of a School of Practical Chemistry.—Mr. James Young, the late proprietor of the extensive works at Bathgate, near Glasgow, and manufacturer of paraffin and paraffin oils, whose name, in fact, is intimately associated with this manufacture as the discoverer of the process by which these valuable products have for many years been produced from certain varieties of coal, is stated to have presented the sum of £10,000 to the Andersonian

Institution, Glasgow, for the endowment of a school of practical chemistry.—*Pharm. Journ.*

Royal School of Mines.—At a meeting of the Council on Saturday, the 3rd inst., the results of the examinations for the past session were declared. The following gentlemen having passed the requisite examinations, have obtained the title of "Associate of the Royal School of Mines" in the divisions mentioned:—Bell, Metallurgical; G. Broome, Mining and Metallurgical; L. Brown, Metallurgical;—Butler, Geological; R. J. Frecheville, Metallurgical; G. Green, Metallurgical and Geological; M. F. Maury, Mining and Metallurgical; F. J. M. Page, Mining and Metallurgical;—Tayler, Metallurgical. The following prizes and scholarships were awarded:—Two Royal Exhibitions of £15 for first year students—(1) J. J. Bowrey; (2) W. Gowland. H.R.H. The Duke of Cornwall's Scholarship, £30 for two years—W. J. Sollas. Royal Exhibition of £25 for second year students—W. Gowland. D. La Beche Medal and Books, for Mining—G. Broome. The Director's (Sir Rod. I. Murchison's) prize for Geology—W. Gowland.

Inexhaustible Manures.—In the Atlantic Ocean, a little to the west of the Azores, there exists a space seven times larger than all Germany, according to the late A. von Humboldt, completely covered with a dense mass of vegetation, the so-called Sargasso Sea. M. J. Lavinière has proposed to the Société d'Agriculture to make these floating meadows, as they are called by Aviedo, subservient to the purposes of agriculture. His suggestion is that the ships occupied during the summer in cod-fishing should, in other seasons, be employed in conveying this abundant and excellent manure to the Azores, where an *entrepôt* could be established, the weeds pressed and dried, and the salts they contain extracted. Analysis has shown that these weeds possess the same fertilising properties as those employed as manure on the French coasts. M. Lavinière calculates that these floating meadows produce annually sufficient vegetable matter to manure 900,000,000 hectares, a hectare being about an acre and a half.—*Revista Industrial, &c.*

Pink Colour and Mineral Lake.—Under the name of pink colour there is met with in the trade, and manufactured by a process which is kept secret, a substance which is chiefly used in this country for painting faience and porcelain. According to M. Malaguti's analysis, this substance is composed, in 100 parts, of—Peroxide of tin, or stannic acid, 78·31; lime, 14·91; silica, 3·96; alumina, 0·95; oxide of chromium, 0·52; chromate of potassa, 0·26; potassa and loss, 0·48. The stannic acid, lime, and oxide of chromium are the essential elements; the silica and alumina are not indispensable; the richness and depth of the colour depends upon the larger quantity of lime and chromate applied in the manufacture. According to M. Gentele, this pink colour may be prepared in the following manner: 1 kilo. of granulated tin is oxidised with nitric acid, and the meta-stannic acid thus obtained is mixed with 180 grms. of bichromate of potassa dissolved in 1 litre of water, and to this mixture there are added 2 kilos. of chalk and one kilo. of finely pulverised glass-sand; these materials are made into a paste, and strongly ignited, after having been placed in a crucible, to a bright red heat; the result of this calcination is ground to an impalpably fine powder, and again ignited, with the addition of carbonate of soda. When a mixture of 100 parts of stannic acid and 2 parts of oxide of chromium is ignited to a bright red heat a beautiful lilac-coloured material is obtained, which is neither injured by daylight nor atmospheric influences, resists the action of sulphuretted hydrogen, and is called by M. Malaguti "mineral lake."

Ink for Writing on Glass.—A solution of fluoride of ammonia is recommended as furnishing a ready means of writing with a pen of any kind upon glass, and is especially adapted for labelling bottles, cylinder-tubes, &c., in the laboratory as well as for marking the degrees upon hydrometers and apparatus of similar construction.—*American Artisan.*

Ashberrium, a New Alloy, consists of 80 parts of tin, 14 of antimony, 2 of copper, 2 of nickel, 1 of aluminium, and 1 of zinc.—*Polyt. Centr.*

New Alloy for Stereotyping.—M. Ed. Hofer-Grosjean recommends the use of an alloy, consisting of lead 50 parts, tin 36, cadmium 225; this alloy is readily fusible, and is harder than the alloy containing bismuth now applied for stereotyping purposes.—*Polyt. Centr.*

Mineral Lemonade.—When equal parts by weight of strong pure sulphuric acid and strong pure alcohol (85 to 90 per cent) are carefully mixed (the acid being poured into the alcohol and thoroughly mixed therewith), a liquid is obtained which has long been known and used by medical men under the older name of *Elixir acidum halleri*, more recently named *Mixtura sulphurica acida*. This fluid, which, if well prepared, contains essentially sulphovinic acid, is an excellent summer beverage when mixed with water in the proportion of one small teaspoonful to a tumbler of cold water, and sweetened with sugar, or, preferably, with some fruit syrup. Above the lemonades made with vegetable acids, this acid mixture has the advantage of not increasing the perspiration, as citric and other vegetable acids do, while, it is better borne by the stomach, and has a tonic action upon the vascular system. It is, indeed, a very pleasant drink, often given, at the *cafés* of Paris, Berlin, Vienna, and other places, along with some *syrop de groiselles* or *framboises*, and rather exorbitantly charged for. The proportions by bulk are—one of strong sulphuric acid and three of alcohol.—*Hamm's Agronomische Zeitung.*

Cellulose in Old Wood.—Mr. Payen has taken the trouble to analyse a piece of old woodwork once belonging to the well-known Chaillot pumps, in order to ascertain what state the cellulose was in, after fully a century's exposure to wind and weather; he therefore treated the wood—first, for eight consecutive days, with a weak solution of caustic potassa (1 part to 10 of water), at a temperature of between 20° and 75° C.; secondly, he treated the residue with nitric acid, sp. gr. 1·2, without applying heat, and also for eight days; next with nitric acid, sp. gr. 1·05, taking care to wash out carefully all substances which, by each of these operations, could have become soluble, previous to proceeding with another operation; M. Payen obtained pure celloluse, as might have been expected, and was evidently also expected by Field-Marshal Vaillant, who happened to be present when the *savant* deposited, at a meeting of the Agricultural Society, a piece of pure celloluse obtained from the wood of the old pump, since the Marshal asked Payen, jocosely, whether he had not some old wood from the ruins of Carthage to operate upon; and M. Robinet, improving upon this occasion, offered to send Payen a piece of wood of Noah's Ark, to continue his researches.

Fusibility and Volatility of Metals.—While engaged with experiments on the intrinsic composition and constitution of various pieces of silver money, made at the Royal Netherlands Mint, at Utrecht, Dr. A von Riemsdyk carried on some experiments on the fusibility and volatility of metals, from the published record of which we abstract the following:—The metals tin, bismuth, cadmium, lead, and zinc, as chemically pure as they can be obtained, were molten, in order to prevent their oxidation, in a feeble, but constant, current of pure and dry hydrogen gas. The author found that—(1) the melting of these metals does not, either mechanically or by evaporation, give rise to any loss at all; (2) that *tin*, *lead*, and *bismuth*, when kept in a liquid state, are not volatile at temperatures greatly in excess of their melting points, and that, at a bright red heat, quantities of 2·3433 grms. of *bismuth*, and 4·5183 grms. of *lead*, did not lose, by being kept at that temperature for one hour, more than 1 and 0·5 m m., respectively, by evaporation, while *tin* did not exhibit any volatility at all; (3) that *cadmium*

and *zinc*, though completely fixed, non-volatile, at their melting point, begin perceptibly to volatilise at a few degrees above that point; (4) that there does not exist any relation at all between the fusibility and volatility of these metals, which may be arranged in the following manner, beginning from the most fusible and most readily volatile:—

Fusibility.	*Volatility.*
Tin.....228·5° C.	Cadmium.
Bismuth.....268·3° "	Zinc.
Cadmium.....320·0° "	Bismuth.
Lead.....326·0° "	Lead.
Zinc.....420·0° "	Tin.

(5) that the so-called Rose's fusible metal, an alloy of tin, lead, and bismuth, the melting point of which is about 97·5°, and certainty not higher, is not perceptibly volatile when heated to a bright red heat in a current of pure hydrogen gas. Silver, unalloyed, melts at 1040° C., pure gold at 1240° C., while the author found that chemically-pure copper requires a temperature of 1330° C. to become liquid. Neither pure silver, nor pure copper, nor also the alloy of silver and copper containing 945-1000ths of the former metal (this alloy is the standard alloy of the Netherlands silver coins), loses anything at all by volatilisation when kept for a considerable time at temperatures higher than the melting points of both these metals, and in a feeble current of pure hydrogen to prevent their oxidation. The author has made some of these experiments on a very large scale, having at his disposal large quantities—several hundred kilos.—of these metals in pure and alloyed state; he also describes an ingenious pyrometer devised and invented by him, but space forbids us to enter into further details.

Alkaloid Formed during Alcoholic Fermentation.—M. Oser has instituted researches with pure sugar brought into fermentation, and, after a series of operations, has succeeded in obtaining an alkaloid composed according to the following formula:—$C_{13}H_{20}N_4$. The hydrochloric acid combination has the formula—$C_{13}H_{20}N_4HCl$; the combination with chloride of gold is expressed by $C_{13}H_{20}N_4$ $AuCl_3$. The author states that this alkaloid is positively the result of fermentation; but he also intimates that, since older wines contain, according to Ludwig's researches, trimethylamine, it is probable that the alkaloid here alluded to is either decomposed in older wines, or is only met with therein in very minute quantities.—*Polyt. Centr.*

Estimation of the Goodness of Soap.—Prof. Schültze, of Rostock, starting from the view that, the better the soap the less thereof will be required for the entire unhardening of water, employs the reverse of Clark's process, in the following manner:—He applies a solution of lime in water containing excess of carbonic acid, so that a litre of water contains exactly 1·6 grm. of lime. Of this fluid he takes 3 c.c. (containing, accordingly, 4·8 milligrms. of lime), and adds 20 c.c. of water, and a small quantity of soda solution; he further applies an aqueous solution of 5 grms. of soft soap in 100 c c, or of the same quantity of solid soap in 200 c.c., of water, and adds of these solutions from a burette to the aforesaid lime solution until a lather is fully and completely formed. The smaller the quantity of soap solution required for this purpose, the better, of course, the soap is; and it is easy to calculate how much of the soap solution has been required for one part, by weight, of lime; a perfectly pure soap, however, will be required, for comparison's sake.

Nitroglycerine.—The only safe and proper mode of permitting the use of this substance is, undoubtedly, that adopted in France, Southern Germany, Belgium, and the United States, that is, to allow its use only on the absolute condition that it be made on the very spot where it is wanted, and be only made in quantities sufficient for, at most, three days' sufficient supply. In an article which appeared in the Chemical News, No. 422, vol. xvii., p. 11 (January 3, 1868; *Am. Repr., March*, 1868, *page* 102), on this subject this point was briefly alluded to; and the experience since obtained in the countries above-named, the United States being foremost in this matter, has fully proved the utility of this rule. Nitroglycerine making is readily taught to workmen, and, with some care, succeeds exceedingly well. There is no sound reason why this plan should not be adopted in this country too.

Hygrometer.—Naudet and Co., Paris, Rue et Place Thorigny, 2 and 4, have constructed a portable hygrometer, shaped like a watch. The measuring of degree of moisture is effected by means of a peculiarly-prepared human hair, 0·35 metres long. The mechanism is graduated by placing the instrument under a bell-jar, wherein the air is kept dry by means of recently burnt quick-lime and fused chloride of calcium; and next it is placed under a bell-jar wherein the air is kept saturated with moisture by means of a wet sponge. The distance between these two extremes, indicated by a properly-constructed mechanism, is divided into 100 parts. The price of this instrument, which is highly spoken of, is 25 francs (£1). It is intended for use in spinning and other establishments, and for observations. —*Deutsche Ind. Zeitung.*

Indelible Ink.—Two solutions are required—No. 1 consisting of—Crystallized chloride of copper, 8·52 parts; chlorate of soda, 10·65 parts; and chloride of ammonium (sal ammoniac), 5·35 parts, to be together dissolved in 60 parts of distilled water. No. 2 solution, consisting of 20 parts of hydrochlorate of aniline, to be dissolved in 30 parts of water, to which has to be added 20 parts of a solution of gum (made by dissolving one part, by weight, of gum in two parts of water), and, lastly, 10 parts of glycerine. These solutions are kept in separate bottles. When it is required to write anything with these fluids, one part, by bulk, of solution No. 1 is mixed with four parts, by bulk, of No. 2. The ink must be applied to paper, linen, cotton, wool, or silk, with a quill pen, or small hair brush; at first, the writing appears greenish, but it soon becomes black, especially if it is exposed to a higher temperature. This writing is perfectly indelible, and can only be destroyed by destroying the fabric it is placed on.—*Dr. Artus's Vierteljahreschrift.*

Production of Oxygen for Industrial Uses.—The works, in running order, although not yet quite finished, are located at the foot of Forty-first Street, in this (New York) city, a malodorous neighbourhood, where some means, artificial or otherwise, would not be out of place in substituting oxygen for the foul emanations of butchers' shops and dirty gutters. The essential or characteristic portions of the process are carried on by the aid of brick furnaces, of which only one was in operation at the time of our visit, several others being, however, rapidly put up and fitted for use. Each furnace has its fire-box so arranged as not only to heat the retort which holds the manganate of soda (the vehicle through which the process is carried on), but also one or more chambers through which an air-blast passes to the retort. The retort, furthermore, communicates, by a pipe furnished with stop-cocks, with a suitable steam-boiler. The process is carried on as follows:—About 600 pounds of manganate of soda are placed in the retort, heated to the requisite degree in the furnace; superheated steam from the boiler is then admitted for about ten minutes. Two equivalents of the manganate of soda and two of water react upon each other, as indicated by the formula—

$$2(MnO_2,NaO)+2(HO)=2(NaO,HO)+Mn_2,O_3+O_3.$$

In other words, the water combines with the soda of the manganate to form a hydrate of soda. The manganic acid is changed to sesquioxide of manganese, containing only half the proportion of oxygen, and the other half of the latter passes off in a free condition. At the conclusion of this part of the process, the steam is shut off, and the superheated air is admitted for about fifteen minutes, whereupon the sesquioxide combines with more oxygen from the air, and is converted back into its original form of manganic

acid, which, of course, resumes its former relation to the soda, reconstituting manganate of soda, ready for a repetition of the process. In forcing the air to the apparatus, a steam-pumping engine is used, noticeable for the manner in which friction gearing is applied to transmit power from the engine to the air-forcing pumps, without the jar incident to the use of cogged wheels. The air-blast passes first through cylindrical vessels containing caustic soda, by which its carbonic acid is removed, and thence through the superheating chamber previously mentioned, to the retort. The retort is never opened, as the material shows no signs of deterioration by use. That in the retort, at the time of our visit was tested continuously for six months before being brought to this country, and has been in constant use for six weeks past, the period during which the works have been in constant operation. As the oxygen leaves the retort it passes through a suitable meter, which registers the quantity, and thence to the gasometer, which, at the present time, contains 25,000 feet of oxygen gas, much purer than is required for most of the purposes for which it is to be employed.—*American Artisan.*

Preservation of Protosulphate of Iron.—M. Welborn states that protosulphate of iron is absolutely preserved and kept from even the very least trace of oxidation, by placing with it a piece of camphor wrapped in a piece of clean and dry paper.—*Deutsche Ind. Zeitung.*

Preservation of Meat.—M. Georges recommends to place the meat into a bath containing 86 parts of water, 10 parts of common salt, 4 parts of glyceric acid or *acide vineux* (glyceric acid is prepared by the author by mixing equal parts of glycerine, water, and hydrochloric acid; *acide vineux* is made in the same way, but instead of glycerine alcohol is added); after this fluid has become thoroughly soaked into the meat it is pressed and squeezed, and next covered with a layer of fat.—*Deutsche Ind. Zeitung.*

Action of Carbolic Acid on Reptiles.—We have been favoured with extracts from an account of some very valuable experiments made by J. Fayrer, F.R.S.E., C.S.I., &c., on the value of carbolic acid in preventing the entry of serpents into dwellings, from which we find that a few drops of the acid are sufficient to quickly kill full-grown cobras and other poisonous snakes. Dr. Fayrer is continuing his experiments on the merits of carbolic acid as a therapeutic agent in snake bite, and, in the meantime, he suggests its use as a preventive against the entry of snakes into houses, &c. Dr. Calvert informs us that it is probable that the acid will save life by applying it, in a caustic state, to the wound caused by the bite of a serpent, and more satisfactory results will be obtained by following the method first put into practice by Dr. Tessier in the Mauritius, for the cure of a virulent intermittent fever. In this case, by injecting under the skin a solution of three-quarters of a grain of carbolic acid dissolved in 20 minims of water, the patients were rapidly cured, and the spread of the pestilence arrested.

Experiments with Flame.—Dr. Hofmann, F.R.S.—Take a piece of canvas, such as is used by ladies for Berlin wool work, and put it on to the top of the superior opening of the glass chimney of an argand gas burner, taking care to envelope the glass chimney previously with a very thin piece of copper foil, while the access of air at the bottom of the burner should be as much as possible prevented. On turning the gas on, it escapes readily through the small openings in the canvas, and the gas may be ignited above. The canvas, however, soon takes fire and burns off, but leaves a very complete circular disc, which remains white and unconsumed in the centre of the frame. If it is desired to demonstrate more completely the nature of the flame, it is done by placing, on the middle of the canvas disc, some gunpowder, and on it the heads of some lucifer matches. After having again turned on the gas, and left it to escape for a few moments, it may be kindled again, and will burn quietly, and even though, as in the first experiment, the excess of canvas again burns off, neither the gunpowder nor matches will catch fire until just at the moment the gas is gently turned off. In order to exhibit the reducing action of the interior portion of a Bunsen gas flame, a spirally rolled-up piece of copper wire is held in the interior portion of the flame by means of a pair of forceps. When this spiral is taken out of the flame while red-hot, and exposed to contact of air, it becomes covered with a black coating of oxide of copper; but if the spiral, instead of being taken out of the central portion of the flame, is lowered down into the current of gas, and there cooled, it will exhibit, on withdrawal, a clean and bright metallic surface.—*Berichte der Deuts. Chem. Ges. zu Berlin.*

Quantity of Water contained in Illuminating Gas.—During the months of February and March of the current year, the author (A. Vogel) instituted on various days, and at different hours during the day and night, experiments with the gas taken directly from the mains of the Munich Gas Works. By causing a slow current of the gas to pass through chloride of calcium tubes, the author found that the quantity of water contained in the gas varied from 0·06 to 0·11 grm. to the cubic foot; it is evident that this quantity may, and naturally will vary according to circumstances. Dr. Vogel next made a current of gas pass through glass tubes placed in a freezing mixture; in this manner he obtained a quantity of ice formed by the freezing of the water contained in the gas; the water obtained on melting this ice had no action upon test papers. By means of Nessler's test, after previous addition of some caustic potassa to the water, ammonia was very clearly indicated to be present. Cyanogen was found therein, by means of Schonbein's test-paper for this substance. When tested with indigo-carmine and sulphuric acid, the decolouration of indigo is observed, while an odour of nitrobenzol is emitted. It hence appears that there is nitrate of ammonia present, and that this is one of the products of the distillation of coal.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

Testing Bees'-Wax.—It appears that both yellow and white bees'-wax is met with in the trade largely adulterated with paraffin. In order to detect this, the following process is recommended:—2 grms. of the wax to be experimented upon are placed in a test-tube; and there is added a solution consisting of 1·5 grms. of solid caustic potassa in about 5 grms. of distilled water, and the mixture boiled, care being taken to shake the test-tube now and then, whereby a thorough though not quite clear mixture is produced. When the fluid has cooled so far down as nearly to reach the point of solidification of the wax, from 6 to 8 grms. of light oil of petroleum is gradually added, and this thoroughly incorporated with the entire mass, so as to form an emulsion, from which, if well made, the light oil does not separate. Next, an excess of an aqueous solution of acetate of lead is added, which is mixed with the mass by stirring with a glass rod. The addition of this lead salt causes the separation of the light oil of petroleum, and in it will be dissolved any paraffin present in the wax. The same operation is twice repeated with the contents of the test-tube, that is to say, petroleum is again and again added, and allowed to separate; the separated petroleum is placed into a retort, and the light oil removed by distillation. Pure yellow wax loses, by this process, from 14 to 16 per cent; but wax has been met which lost 57 per cent in weight; the specific gravity of the residue of adulterated wax was 0·88. When it is desired to obtain the paraffin in a pure state freed from any dissolved wax, this may be effected by cautiously decomposing the wax supposed to be adulterated with paraffin, by means of fuming sulphuric acid, which does not affect paraffin.

The Zirconia Light.—The oxygen process of M. Tessie du Mothay, according to the Paris correspondent of the *British Journal of Photography*, consists in heating, in iron retorts divided in two by a horizontal grating, a quantity of manganate of soda. This is heated to a dull red, and a cur-

rent of superheated steam is made to pass over the mass. Oxygen is given off in abundance, and passes along with the current of steam into a refrigerator, where the steam is condensed into water, and the oxygen is afterwards collected in a gasometer. When no more gas comes off, the manganate is exhausted. The next operation is to re-oxygenise the exhausted manganate. This is accomplished by passing heated *air*, not steam, over it, when the manganate absorbs the oxygen, and becomes as ready as ever for yielding it again to the vapour of water. Thus, the two operations can go on for an indefinite time, the air being the source of supply of oxygen. It has been found that carbonic acid gas is detrimental to the production of oxygen, and so the air is deprived of this before it acts upon the manganate of soda. One advantage claimed by the advocates of the zirconia cylinders, besides their durability, is that a mixture of *equal* parts of oxygen and carburetted hydrogen can be used instead of a mixture in which oxygen is in excess, as is usual. The magnesia for the magnesian cylinders must be very pure, and free from silica, or they will not be durable under heat.

Manufacture of Sugar.—*The Journal des Fabricants de Sucre* states that experiments are now in progress in some French colonies to try, on a large scale, Messrs. Rousseau and Bonnaterre's plan of converting the saccharine juice of cane or beet-root into a peculiar saccharate of lime, and to transport that salt, instead of raw sugar, for the purpose of refining. It is said that this compound is as hard as sand, and can be transported without the risk of damage and injury sugar is subject to, and be kept for any length of time.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half yearly volumes of the* CHEMICAL NEWS, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers on a level with the latest advances of science.*

NOTE.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Comptes Rendus des Séances de l'Académie des Sciences (No. 25), June 21, 1869.

Omitting the purely astronomical, mathematical, and other memoirs and papers of no direct interest to the readers of our paper, we notice a memoir—

On a Homologue and Isomer of Choline.—M. Wurtz.—The author says—Some time ago I pointed out that, when chlorhydrate of glycol fixes and combines with trimethylamine, the result is the formation of a new basis identical with neurine as obtainable from brain. Since the identity of choline, which M. Strecker has extracted from liver, and the base just alluded to, has been proved, I shall call neurine henceforward choline. The reaction above mentioned is represented by the following formulæ:—

$$(C_2H_5)_3N + C_2H_4\left\{\begin{matrix}OH\\Cl\end{matrix}\right. = \left.\begin{matrix}C_2H_4.OH\\(C_2H_5)_3\end{matrix}\right\} NCl.$$

Triethylamine. Chlorhydrate of glycol. Chlorhydrate of hydroxethylentriethylammonium.

This salt is soluble in water and alcohol, crystallises in prisms, and yields, with chloride of platinum, a crystalline double-salt made up according to the following formula:—

$$\left[\begin{matrix}C_2H_4.OH\\(C_2H_5)_2\end{matrix}N.Cl.\right]_2 + PtCl_4.$$

The hydrate of hydroxethylen of triethylammonium, $C_8H_{21}NO_2$, is evidently a homologue of chinoline, $C_9H_{15}NO_2$. The author's paper describes, at very great length, the preparation of many complex compounds like those named, and, lastly, promises a detailed account of this portion of his labours.

Some Isopropylic Compounds.—M. Da Silva.—Butyrate of isopropyl is a colourless liquid; odour disagreeable; boils at 128° C.; is inflammable, and burns with a bright flame. Its vapour density is 4·73.—Valerate of isopropyl is also a liquid, colourless, inflammable, of a disagreeable odour, and of less density than water. Its specific gravity, at 0° C., is 0·8702; vapour density, 5·004; and boils at 142° C.

Coal-Tar Oils which Boil at about 200° C.—M. Romier.—The author says—Having obtained, through the kindness of the chief engineer and chemist of the United Parisian Gas Works Company, M. Audouin, 16 litres of heavy coal-tar oil, I have therefrom obtained about 4 litres of oil, perfectly freed from naphthaline, phenol, and alkaloids, and boiling at between 170° and 225° C. Leaving out of the subject of his research all fluids contained in the aforesaid 4 litres boiling below 176° C., and which in bulk represented 3½ litres, the author has obtained three oils of constant boiling point, respectively boiling at between 176° and 179°, at between 196° and 198°, and, lastly, at between 200° and 225° C. These oils are colourless, lighter than water, and exhibit an odour reminding one of that of oil of turpentine; they have been submitted to a series of experiments; and the author states that they are cymens and hydrides of formen.

Analysis of the Meteorite of Kernouve, near Cleguerec, Morbihan, Fallen on the 22nd of May last.—M. Pisani.—The entire weight of this mass, before it was broken up, was about 80 kilos.; the piece from which a portion has been applied for analysis weighed 16 kilos. The specific gravity of this meteorite is, on an average, 3·747. The result of the analysis, in 100 parts, was as follows:—Iron, 22·25; nickel, 1·55; sulphur, 2·15; copper, a trace; chromate of iron, a trace; silica, 32·95; alumina, 3·19; protoxide of iron, 11·70; magnesia, 23·68; lime, 1·89; soda, with traces of potassa, 1·41.

Polytechnisches Centralblatt, No. 9, May 1, 1869.

We do not propose regularly to quote this periodical, which is chiefly devoted to mechanics and engineering; but whenever it happens to contain either original papers of interest to our readers, or, as now and then occurs, abstracts of interest from German, Swedish, or Russian periodicals, which from their limited circulation have not become generally known, we shall make the necessary abstracts.

Ready Method of Preparing Phosphuretted Hydrogen Gas.—Dr. H. Schwartz says, When the pulverulent metallic zinc which is deposited in the tubes of the Belgian (Vieille Montagne) zinc smelting furnaces, is mixed with amorphous phosphorus in powder, in the proportion of one part of zinc to two of phosphorus, and this mixture, after having been introduced into a hard-glass combustion tube, is gently heated therein, while, at the same time, a current of dry coal gas or dry hydrogen gas is passed through the mixture, phosphide of zinc is formed; it is necessary to cool the tube and mixture while the current of gas remains turned on. From the phosphide of zinc so obtained phosphuretted hydrogen may be readily prepared by means of dilute sulphuric acid, or by boiling with caustic potassa solution; the gas evolved is, however, the non-spontaneously combustible kind; the spontaneously combustible gas may be obtained by applying a larger quantity of the phosphide of zinc and warm dilute sulphuric acid.

Analysis of some Colouring Substances used for Staining Glass and Faience Ware.—Dr. H. Schwartz.—A bright brown colour was found to consist in 100 parts of—Oxide of chromium, 11·30; peroxide of iron, 21·00; alumina, 18·02; oxide of zinc, 50·90; this material may be prepared as follows: 71 grms. of chrome alum; 60 grms. of persulphate of iron; 160 grms. of alum, and 180 grms. of sul-

phate of zinc, are dissolved in water, and after having been mixed, precipitated by means of carbonate of soda, collected on a filter, washed, dried, gently ignited, and rubbed to powder in an agate mortar; a reddish brown colour consisted in 100 parts of—Oxide of barium, 19·82; oxide of chromium, 11·07; peroxide of iron, 7·70; alumina, 2·30; silica, 10·40; sulphuric acid, 5·47; carbonic acid and alkali, 3·81.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiii.

This periodical contains only one paper relating to chemistry—A memoir, or rather, and more correctly, a fresh instalment of a memoir:—

On Hydrocarbons.—M. F. Fritzsche.—(Read at the meeting of the 4th of February last). The author says, I call Phöten the substance $C_{14}H_{10}$, fusing at 210° C.; in pure state it is always a somewhat yellowish-coloured solid, soluble in very strong alcohol, exhibiting in solid as well as in a fused state a violet fluorescence. Phosen, another hydrocarbon, fuses at 193° C.; by the action of sunlight this substance is entirely altered in its properties, and the so-altered matter is called paraphosphen by the author; by simple fusion this latter is again converted into phosen. The author describes at great length the preparation in pure state of the two substances alluded to, discusses their crystallographical properties; describes oxyphoten $C_{14}H_8O_2$; oxybinitrophoten. dioxyretisten $C_{16}H_{14}O_2$; but these descriptions and the record of the properties, and mode of preparation of these substances, are so lengthy, and, moreover, so interspersed with discussions on other, although not in this respect quite irrelevant, matter, that it is impossible to give a condensed abstract which will do justice to the author.

Comptes Rendus des Séances de l'Académie des Sciences (No. 26), June 28, 1869.

We observe, in the first place, that Sir Roderick Murchison was present at this meeting of the illustrious scientific society of France, of which he has been elected a Foreign Member; being present for the first time after his election, he was most heartily received by the large number of *savants* present. The speech made by the celebrated British geologist was the signal for M. Dumas to say a few words, highly eulogising the excellent reception given to him while lately at London, and stating that, in the person of one of their perpetual secretaries, the British scientific world and renowned *savants* had honoured and fêted the Academy. We notice the following papers:—

Mode of Condensing Magnetism Analogous to the Condensation of Electricity.—M. Jamin.—The author has caused M. Limet to make for him a horseshoe-shaped magnet, made up of ten bars of perfectly homogeneous steel, and fastened together by means of bolts. When this artificial magnet is properly magnetised, it is capable of bearing a weight of 300 kilos. at the armatures. When this armature is placed so as to be only in contact with one of the steel bars composing the horseshoe, it appears that the magnetism of the nine other bars is very perceptibly diminished. Under these conditions, and, notwithstanding the magnet was previously already saturated with magnetism, it is possible to saturate anew with magnetism, and make the horseshoe bear again 600 kilos. This experiment can be repeated: another armature may be put on, so as to bear only upon one of the component bars, and, again, more magnetism can be condensed. The learned author has already succeeded in making the horseshoe bear another 680 kilos. in this manner.

Researches on the Oxygenated Bases—Action of Chlorhydric Glycol on Toluidine.—M. Wurtz.—This is another instalment of the papers resulting from the author's labours on this subject. The paper here alluded to contains researches on the action of chlorhydric glycol upon aniline and toluidine. When a mixture of aniline and chlorhydric glycol are heated together on a water-bath, a thickish and coloured liquid is obtained, which yields, with a concentrated solution of chloride of platinum, a very unstable, readily-decomposable salt. When the mixture of substances just alluded to is heated in an air-bath to from 195° to 210°, and the fluid afterwards treated with water, and filtered, an abundant precipitate is formed with a concentrated solution of chloride of platinum. This salt, having been well purified, yields, on analysis, results leading to the formula—

$$(C_{12}H_{18}ON.Cl)_2,PtCl_4.$$

When toluidine is thus acted upon by chlorhydric glycol, the author obtains three bases—(*a*) vinyltoluidine—

$$C_9H_{11}N=\left.\begin{matrix}C_7H_7\\C_2H_3\\H\end{matrix}\right\}N;$$

(*b*) two other bases of complex composition, containing no longer toluyl, but the radical C_7H_5, toluenyl; while one of these bases contains, besides toluenyl, also two vinylic groups.

New Researches on Hydrogenium.—Mr. T. Graham.—From this paper we quote, in the first place, that the author finds the specific gravity of hydrogenium to be 0·872. The eminent *savant* records in this paper, consecutively, researches on—*palladium, platinum, and hydrogenium; palladium, gold, and hydrogenium; palladium, silver, and hydrogenium; palladium, nickel, and hydrogenium.* We give these researches in a separate paper on another page.

Poisonous Effects of Coralline.—M. Landrin.—This paper, or report, rather, contains the results of the researches made at the request of the celebrated Dr. Tardieu, and the members of the Academy of Medicine. The result of carefully-made experiments, also by giving large doses of coralline to animals and applying it to their skin, is that coralline is no poison at all, whether internally or externally applied; and its use in dyeing is quite harmless, provided it be not mixed with substances which are very decided poisons.

Certain Stellar Spectra.—M. Janssen, in a letter dated from Darjeeling, Sikim, British India, 22nd May last, says that the spectra of some stars, which are rather ruddy-coloured when not disclosing the presence of hydrogen, do positively disclose the presence of aqueous vapour.

Spectra which some Compound Substances Exhibit when Produced within Gaseous Mixtures which are in a state of Equilibrium.—Messrs. Berthelot and Richenau.—This paper is not suited for proper abstraction.

Presence of Peroxide of Hydrogen in the Atmosphere.—M. Struve.—The author, writing from Tiflis (a large town on the Caucasian side of Russia), calls attention to some interesting facts observed by him in reference to the quantity of nitrite of ammonia, ozone, and oxygenated water (peroxide of hydrogen) present in rain-water, and water obtained from melting snow and hail. The author applies oxide of lead as a test, which is converted into peroxide. M. Sainte-Claire Deville reminded the meeting that, while—in July and August, 1859—he was engaged in making some researches (he was, during that time, staying on the St. Bernard); on ascending two mountain tops, named Le Vélan and Le Combin, respectively 3762 and 4430 metres high, he collected there rain and snow water, which, on being analysed by M. Boussingault, was found to contain so much ammonia and nitric acid that, were it not that several bottles of the same sample were taken, it might have appeared as if bottles which were not well cleaned had been applied for collecting the fluids.

Heat of Combination of Hydrosulphuric and Hydroselenic Acids.—M. Hautefeuille.—This paper is too abstruse for condensation.

Theory of Etherification by means of Hydrochloric Acid.—M. Friedel.—When it is desired to obtain

a compound ether, the mode of obtaining it often resorted to is, to mix the acid of which it is desired to have the ether with alcohol, and to pass through this mixture a current of hydrochloric acid gas. The author proves that, in that case, there is formed first a chloride of the acid radical, and that that chloride afterwards gives rise to the formation of the compound ether. The author describes at length a process whereby it is possible to obtain, by the action of hydrochloric acid gas upon benzoic acid, chloride of benzoyl.

Primitive Normal Butylic Alcohol.—Messrs. Lieben and Rossi.—This lengthy paper contains the results of experiments made by the authors to prove that a compound discovered and described by M. Wurtz as a butylic alcohol, in the year 1850, is only an isomer of the true and genuine butylic alcohol obtained in a peculiar manner, described at great length by the authors, and wherein an aldehyde plays an important part. We conclude these abstracts by simply quoting the titles of the following papers, which are either purely physical, or are not well suited for proper abstraction with due justice to their contents, and the labours bestowed thereupon by their authors:—

Compressibility of Liquids.—Messrs Amaury and Descamps.

Measure for the Conductive Power for Electricity of such Fluids as are Generally Hitherto considered as Non-Conductors.—M. Saïd Effendi.

Alcoholic Fermentation Excited by the Microzymas of the Liver.—M. Béchamp.

Toluylen-Diamine.—M. G. Koch.

Researches on Inuline and the Acetic Acid Derivatives therefrom.—Messrs. Ferrouillat and Savigny.

Deutsche Industrie Zeitung, May 24, 1869.

Detection of Arsenical Pigments.—M. C. Puscher states—That during the first five months of this year, no less than eight cases of accidental poisoning by these pigments have occurred at Nürenberg; he advises the use of liquid ammonia for the detection of these pigments, all of which, he says, are soluble therein, exhibiting a blue-coloured solution, if copper is at the same time present; he further states that, on the evaporation of the ammonia, there remains a dirty greenish-coloured precipitate of arsenite of oxide of copper; his advice is to paint some *white* paper with this solution in ammonia, which painting, when dry, if arsenic were present, will exhibit a dirty-greenish colour, but if after drying a blue colour appears to have been imparted to the paper, the pigment is quite free from arsenic, and only consists of a compound of copper, of which latter metal there are several in use, as green and blue pigments, all soluble in ammonia, except such adulterations as do not essentially belong to the pigment itself.

The Journal of the Franklin Institute (No. 4), April, 1869.

We notice from this paper the following communications and papers:—

Spectrum Lines, a New Method of Illustrating them.—At a late meeting of the American Institute, Professor E. C. Pickering, of the Massachusetts Institute of Technology, employed the following method to illustrate his paper on spectrum analysis. A sheet of black lace, 1½ ft. broad and 3 ft. high, was suspended as a screen, and upon it was thrown a continuous spectrum from a magnesium light, arranged in the manner first developed for electric light by Professor Cooke, of Cambridge, U. S., except that only one bisulphide of carbon prism was used. The spectrum covered the entire lace screen, the curvative of its lines being corrected by an opposite curvature of the opening through which the light passed. Upon this black lace were attached a number of strips of white paper, so arranged as to occupy the places of the bright lines in seven different spectra, such as those of sodium, potassium, rubidium, cæsium, &c. These being illuminated by the variegated light of the continuous and broad spectrum, received and reflected each colour corresponding to its position, and, therefore (their adjustment being accurate), that which actually belonged to the band which it represented. The light falling between these paper bands was, of course, not reflected, and the appearance, therefore, was in each case (as in an actual spectrum) that of bright-coloured lines on a dark ground. When, however, as in the case of potassium, the nebula of Orion, &c., a faint continuous spectrum is, in fact, combined with that of the bright lines, this, also, was represented by attaching, in the required places, bands of white lace, which reflected enough of the coloured light to produce a hazy spectrum, admirably imitating that of the substances or bodies in question.

Acid-Proof Cement.—R. F. Fairthorne.—It frequently happens that the chemist requires some means for protecting cork from the destructive action of vapours such as arise from boiling nitric acid; the author found the following plan to meet this requirement:—Finding it necessary to connect a glass tube with a wide-mouthed flask, and, in so doing, to use a cork, which was exposed to the action of the fumes from boiling nitric acid for several hours, the author found the best preservative to consist of a coating of silicate of soda and powdered glass. The cork, having been bored to suit the size of the tube, was soaked for two or three hours in a solution of silicate of soda, consisting of one part of commercial concentrated solution to three parts of water. The tube was next inserted, and, when dry, the cork was covered with a paste, made by mixing the concentrated solution of the silicate with powdered glass, in such proportions as to form a mass of about the same consistency as that of putty. This is spread on the under surface, and then washed with a solution of chloride of calcium. It soon hardens; so that it is advisable to make the connection with the flask whilst the paste is in a plastic state, and to allow it to become solid before applying heat to the vessel containing the acid. Corks protected in this manner were but slightly acted upon after remaining over the boiling nitric acid more than four hours, and over hot acid for ten. The cement, the preparation and use of which is herein described, is very useful for general use as a luting for chemical apparatus.

Hot-Cast Porcelain.—Charles P. Williams.—This is the trade name of a peculiar tough, milk-white, translucent glass, not unlike French porcelain in appearance, and extensively made at Philadelphia and Pittsburgh, U. S. It is intermediate in character between the glasses produced by the addition of phosphate of lime to the ordinary glass materials, on the one hand, and the white enamels, such as are produced by oxide of tin on the other, having more of the milkiness than the former, and less opacity than the latter. The raw materials consumed in its production are sand, oxide of zinc, and cryolite, which are melted together in the ordinary clay pots of the glass-maker. The following is the composition of an average sample of this glass, taken when the "metal" was in its best working condition:—Silica, 63·84; alumina, 7·86; peroxide of iron, 1·50; protoxide of manganese, 1·12; oxide of zinc, 6·99; lime, 1·86; magnesia, 0·25; soda, 10·51; fluorine, 8·05; [less oxygen (corresponding to the fluorine), 3·39]=98·59 for 100 parts. The above is the mean of five analyses. The method pursued in the above analyses consisted in fusing the compound with carbonate of soda, extracting with water, and, after precipitating the silica and alumina in the aqueous solution by means of carbonate of ammonia, separating the fluorine as fluoride of calcium mixed with carbonate of lime, by the addition of chloride of calcium. The mixed salts were afterwards treated with acetic acid, and the separated fluoride of calcium, dried, burned, and weighed. The remainder of the analyses was conducted as is usual in the analysis of silicates, the alumina and oxide of iron being precipitated as basic acetates, and separated, after weighing, by means of tartaric acid and sulphide of ammonium. Admitting the fluorine to exist in the glass in the condition of silico-fluoride of sodium

(NaF,SiF_2), the following formula will express the composition of the compound:—

$$2[R_2O_3 3SiO_2 + 3(RO3SiO_2)] + NaFSiF_2.$$

Zeitschrift für Chemie, von Beilstein, No. 9, 1869.

The original papers contained in this periodical are—

Monochlorocrotonic Acid and its Salts.—M. O. Froelich.—When two parts by bulk of perchloride of phosphorus act upon one part, by bulk, of ethyldiacetic acid, two new acids containing chlorine are formed; both are crystalline, and they are isomeric with each other; only one of these acids, the monochloroacetic acid,

$$C_4H_5ClO_2, (C=12, O=16),$$

has been further investigated; the pure acid is a solid substance, exhibiting crystalline structure, fusing at 59°C.; becoming solid again at 55° C.; boils at 194·8° C.; it is a rather volatile substance. prone even to sublime when kept in closed bottles, at the ordinary temperature of the air. It is not very soluble in water; at 7° C. one part of the acid requires 79 parts of water for solution; readily soluble in ether and alcohol. It is a rather powerful acid, easily decomposing carbonates. The author has prepared a series of salts of this acid with alkaline, earthy, and metallic bases: the potassa salt, $C_4H_4ClO_2,K+H_2O$, is crystalline, like almost all of the salts this acid forms. Monochlorocrotonic acid-ethyl ether, $C_4H_4ClO_2(C_2H_5)$, is a colourless, oily fluid, possessing an aromatic odour and a cooling taste, boils at 161·4° C. Its specific gravity at 15° C. is 1·113. Slightly soluble in water, readily in alcohol and ether; does not affect the vegetable colours, as, for instance, litmus. The methyl-ether analogous with the preceding—

$$C_4H_4ClO_2(CH_3)$$

is an oily fluid boiling at 142°; its specific gravity at 15° is 1·143. Insoluble in water, less soluble in alcohol than the preceding.

Presence of Peroxide of Hydrogen in the Atmosphere.—M. H. Struve.—The author, writing from Tiflis, Central Russia, states that his observations and researches of the water of the river Kurr, after a heavy rain or snow-storm, led him to detect therein first, ozone, next peroxide of hydrogen, and afterwards nitrite of ammonia. In order to detect peroxide of hydrogen in rain or snow-water, the author adds to 25 c.c. of water, 5 drops of a clear iodide of potassium and starch solution, and next a single drop of a solution of sulphate of protoxide of iron and ammonia. When only traces of HO_2 are present, a blue colouration soon ensues, but soon also disappears. The author has not made any quantitative researches, but he avers that, owing to the presence of HO_2 in the water obtained from snow and rain, at Tiflis at any rate, and in that portion of Europe, peroxide of hydrogen may be present.

On some Derivatives from Methylen.—M. Butlerow.—Chloride of methylen, CH_2Cl_2, was prepared from pure iodide of methylen, by passing a current of chlorine through it while placed in a distilling apparatus under water, and a long-continued purifying process; the chloride of methylen is a colourless, very mobile fluid, exhibiting a smell akin to that of chloroform, and like that endowed with a sweet, burning taste. Chloride of methylen is somewhat soluble in water; its specific gravity is at 0°C. 1·3604; it consists, in 100 parts, of—C, 14·12; H, 2·35; Cl, 83·53. Hexamethylenamin is the result of the action of oxymethylen and ammonia upon each other; this base yields with hydrochloric acid a crystalline compound, $C_6H_{13}N_4Cl$.

Bromated (Gebromtes) Toluidin.—When it is desired to prepare bromated aceto-toluidin, the latter substance is placed in a vessel and water is poured over it, and next bromine is added in small quantities at the time; the monobromated aceto-toluid, $C_7H_6BrN(C_2H_3O)H$, is a solid, crystallizing in needle-shaped crystals, difficultly soluble in water, readily so in alcohol; fuses at 117·5°C.; bromated-toluidin is a colourless liquid, boiling at 220°C., insoluble in water; specific gravity 1·510 at 20°C. The nitrate of this last compound, $C_7H_6Br.NH_2.HNO_3$, is a beautifully crystalline substance, not readily soluble in water, fusible at 182° C., but at the same time becoming decomposed.

Action of Sulpho-Chloride upon the Bromide and the Iodide of Ethyl.—M. E. Wroblevsky.—SO_2HCl does not exert any action at all upon $C_4H_4Br_2$ until the heat of a water bath is applied; HBr and Br then escape. After dilution with water, neutralisation with $BaCO_3$, and a careful evaporation, the author obtained a salt, $(C_2H_4Br.SO_4)Ba_2$. SO_2HCl acts very energetically upon C_2H_5I, while, thereby, separation of HI and I takes place. When SO_3, anhydrous sulphuric acid, is made to act upon $C_2H_3Cl_3$, and the product was saturated with baryta, the barium salt was obtained of a very unstable chlorinated compound.

Series of Isomeric Derivatives from Toluol.—MM. Beilstein and Kuhlberg.—Paranitrotoluidin, $p.C_7H_6(NO_2)(NH_2)$, is prepared by the reduction of dinitrotoluol and hydrosulphide of ammonium; it exhibits a yellow-coloured crystalline mass, fuses at 77°, is soluble in hot, not so well in cold, water; the nitrate, hydrochlorate, and sulphate of this base are all crystalline substances. Nitrate of paradiazo-nitrotoluol, $p.C_7H_6(NO_2)N_2.NO_3$, is obtained by treating nitrate of para-nitrotoluidin with nitrous acid. Of the long series of derivatives obtained, we only mention yet β nitrotoluol. $\beta C_7H_7(NO_2)$ is a liquid boiling at 222°C., having, at 25°C., a specific grauity of 1·163; is not acted upon by chromic acid.

Observations concerning the Essay of Fremy on Hydraulic Cement.—M. A. Schulatschenko.—The only matter of interest to our readers in this paper (which reviews all which has been stated and done from the year 1786, beginning with the celebrated Chaptal, up to the present day, as regards the hydraulic and other cements, especially in respect to the cause of the hardening under water as well as in air), is the analysis of a marl found on the borders of the river Wolchow, Russia, and applied to the manufacture of cement by careful burning. In 100 parts, this material contains—Carbonate of lime, 63·84; carbonate of magnesia, 5·78; peroxide of iron and alumina, 3·22; sulphate of lime, 0·32; water, 1·04; the remainder was insoluble in hydrochloric acid, and consisted of—Silica, 18·16; alumina, 2·02; peroxide of iron, 3·56; potassa and soda, 1·66; together, 99·60. This material yields, after burning, a product which, on being treated with water, becomes strongly heated, swells up and falls to powder, as does burnt limestone, but unlike it, the material alluded to hardens slowly under water; if, however, this marl happens to be more strongly burnt, exposed to more than a faint red heat, not visible in daytime, a product is obtained which does not, on coming into contact with water, act as just described, but which very rapidly sets and hardens under water. The author observes that we have to distinguish two kinds of cement—such as contain lime in a free state, the Roman cements of M. Winkler, and the hardening of which has been fully explained by Fuchs, and such cements as do not contain lime in a free state, the Portland cements of M. Winkler, the hardening of which is as yet not well explained. According to M. Rivot and others, the cause of the hardening is due to the binding of water by the silicates formed during the burning, while, according to Winkler and others, the effect of water and the cause of hardening is due to the splitting up of silicates into more simple silicates. It is a fact, however, that the action of lime upon Puzzolanes is not sufficiently great solely to explain the hardening of cements.

No. 10, June 8, 1869.

We learn from this number that a very flourishing Chemical Society has, with the permission of the Imperial Government, been established and recognised as one of the scientific institutions of the Russian Empire; the transactions of this society are to be published in the Russian language. The only original paper in the above-named periodi-

cal is the record of several researches made at St. Petersburg—

Isomeric Phenolsulpho-Acids, and the Action of Chloride of Benzoyl on the Potassa Salt of that Acid.—M. Solomanoff.—according to the author's researches, there exist three isomeric phenolsulpho-acids, all of which are simultaneously formed when sulphuric acid acts on phenol. The author distinguishes these acids by α, β, and γ, or by prefixing to the two first para and meta; the author prepared these acids in rather large quantities; the potassa salts of these acids are distinguished from each other by the following particulars: the α salt, $C_6H_5KSO_4$, crystallises in six-sided foliated crystals, is the most difficultly soluble of the three salts in water, fuses at 240° C.; the β salt crystallises in needle-shaped crystals, and is capable of taking up variable quantities of water of crystallisation, varying from 1·01 per cent to nearly 15 per cent; it fuses at between 235° and 240° C., yielding a yellowish liquid; the γ salt contains from 16·28 to 17·51 per cent of water of crystallisation, does not, on being heated, melt until it just reaches 240° C. When α phenolsulpho-potassium is heated with chloride of benzoyl, hydrochloric acid is given off and benzoyl-phenolsulpho-potassium is obtained; this salt is soluble in water, and crystallises from its solutions therein in large needle-shaped crystals; the corresponding γ compound, after having been dried at 130° C., is composed according to the formula $C_6H_4(KSO_3)O(C_7H_5O)$; it is difficultly soluble in cold water, but readily in hot water; also soluble in warm alcohol.

Action of Chlorosulpho-Anhydride, $HClSO_3$, on Phenol and Phenolsulpho-Potassium.—MM. Engelhardt and Latschinoff.—The authors made some experiments in order to ascertain whether, when instead of sulphuric acid the compound SO_3HCl was made to act upon phenol, the result would be the formation of one acid only, or of three isomeric acids, as in the instance just previously alluded to; when to one equivalent of phenol, one equivalent of SO_3HCl is added, a very strong reaction takes place, the mixture becomes hot, hydrochloric acid is given off, a thickish red-coloured mass is obtained, from which, by gently heating, all hydrochloric acid was expelled; the mixture after having been formed into a potassium salt, this proved on analysis to be pure α or para phenolsulpho-potassium; the authors made experiments with divers proportions and quantities of SO_3HCl and phenol, and found as result chiefly the production of the acid of the salt just referred to.

Phenol Phosphosulpho-Acid.—M. Maikopar.—The author has studied the action of sulphuric anhydride upon phosphate of phenol, and also the action of phosphor oxychloride upon para phenolsulpho potassium; the author describes at great length his researches; dry phenol phosphosulpho-barium, $(C_6H_4BaSO_3)_3PO_4$, gave in 100 parts—Baryta, 27·72; sulphuric acid, 29·84; and phosphorus, 4·03. When oxychloride of phosphorus was heated with dry para phenolsulpho-potassium a solid mass was obtained; on exhausting this with ether the latter left on evaporation an oil which was found to contain chlorine, phosphorus, and a substance belonging to the phenolsulpho-acid group; but the results of the analysis of this substance gave figures from which no definite formula could be deduced.

On Murrayin, a Newly-Discovered Glucoside.—Prof. Blas.—The author states that he received from Dr. de Vrij a quantity of murrayin, extracted by the latter gentleman from the *murraya exotica* during his sojourn in the East Indies; in pure state murrayin is a white coloured solid substance, exhibiting needle-shaped crystals, its taste is slightly bitter; it is difficultly soluble in cold water, and insoluble in ether, readily soluble in boiling water and in alcohol; these solutions are neutral to test paper. Murrayin fuses at 170°C.; is readily soluble in solutions of caustic and carbonated alkalies; these solutions exhibit a high degree of fluorescence, they appear yellow in direct light, greenish blue when the rays of sunlight are made to pass through the solutions; crystallised murrayin has the formula $C_{36}H_{44}O_{20}+H_2O$; when one part of murrayin is mixed with one part of strong sulphuric acid, and 25 parts of water, and this mixture heated in a sealed tube or in a flask, in an atmosphere of carbonic acid, the substance is split up, murrayetin and sugar being formed; this splitting up takes place according to the following formula:—

$$C_{36}H_{44}O_{20}+2H_2O=\underbrace{C_{24}H_{24}O_{10}}_{\text{Murrayetin.}}+2C_6H_{12}O_6.$$

Murrayetin is a solid substance, which readily crystallises its concentrated solutions have a weak acid reaction; with perchloride of iron, it yields a beautiful blue colouration.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 1, July 5, 1869.

A very considerable portion of this number is filled with a lengthy discussion on some ancient letters and papers of historical interest. Incidentally with this subject, M. Balard stated that, having made use of M. Carré's plan to immerse written papers in dilute hydrochloric acid (one part, by bulk, of acid, to ten parts of pure water), he found very old writing to resist, even for fully twenty-four hours, the action of this acid, and that, although the figures become rather yellowish, they were perfectly and distinctly legible; yet, though this holds good for the documents operated upon, which were written between the years 1577 and 1770, it does not for documents tested in the same manner and written between the year 1793 and 1867. The observation was made that some ancient writing turned red in the acid; and, since this indicated the use of logwood in the ink, it was doubted whether this material had ever been applied at so remote a date as even the end of last century for ink making. M. Balard stated that he had found, in books printed and published more than 100 years ago, prescriptions to make black writing ink with logwood. M. Chevreul asked M. Balard whether he had tested the inks for oxide of manganese, since some prescriptions for the manufacture of black writing ink advise the addition of a salt of the protoxide of this metal, in order thereby to have a means of detecting any attempt to destroy the writing by means of chlorine. M. Chevreul pointed out the great difficulties in testing, by such methods, any writing, owing to the composition of the ink, the kind of paper, whereon is written, its sizing, and the very varying conditions wherein written documents may have been kept.

Researches on the Galvanic Battery, and the Origin of the Heat which is Produced in the Elements and is not Transmissible to the Conducting Wires.—M. Favre.—This is another portion of a lengthy memoir on this subject, and is full of a series of tabulated results, which cannot be left out without impairing the value of the research; we therefore only quote the title.

Poisonous Properties of Coralline, as used for Dyeing Purposes.—M. Tardieu.—This author, although not wishing directly to contradict M. Laudrin, insists upon the fact that silk stockings, dyed with coralline, and absolutely free from any such substances as arsenic, mercury, or lead, cause, to those who wear these on their feet, in many instances, grave inconvenience, certainly not due to the silk, and thus, inferentially, due to the dye.

Heat of Transformation of some Isomeric Bodies.—MM. Troost and Hautefeuille.—This memoir, a physico-chemical essay, treats of—1st, the heat of transformation of cyanic acid into cyamelide; 2nd, the heat of transformation of cyamelide into cyanuric acid; 3rd, on the relation which exists between the heat given off by the combustion of a substance and its specific gravity (under this head, sulphur and arsenious acid are treated).

Relations which Exist between Amido Acids, derived from Benzoic Acid, and the Alkaloids derived from Toluen.—M. Rosenstiehl.—The author says, there exist three acids, the composition of which is

expressed by the formula $C_7H_5(NH_2)O_2$; they are—the *amido-benzoic*, *amido-dracylic*, and *anthranilic acids;* we are acquainted, moreover, with only two homologous alkaloids—to wit, *toluidine* and *pseudo-toluidine*. In order to elucidate the question, What relation there exists between these acids and the alkaloids, the author has acted upon these acids with hydriodic acid at a temperature of from 180° to 200°. The amido-benzoic acid yields pure toluidine, without any secondary product; amidodracylic acid yields pseudo-toluidine, but a secondary reaction takes place simultaneously, whereby carbonic acid, aniline, and hydride of methyl are formed; anthranilic acid behaves as amidodracylic acid.

Solubility of Sulphur in Coal-Tar Oils.—M. Pelouze.—The author has operated with light benzines, sp. gr. 0·870 to 0·880, the former boiling between 80° and 100°, the latter between 85° and 120°; heavier benzines, sp. gr. 0·882 to 0·885, the former boiling at from 120° to 200°, the latter at from 150° to 200°; heavy oils, sp. gr. 1·010 to 1·020, the former boiling at from 210° to 300°, the latter at from 220° to 300°. The temperatures at which the solvent action upon sulphur was tried with these divers liquids, varied from 15° to 130°. The light benzines dissolve in the range of temperature up to their boiling point, from 2·5 per cent to 27 per cent of sulphur; the heavy benzines dissolve, for the same range of temperature, from 2·5 per cent to 38·7 per cent of sulphur; while the heavy oils dissolve in a range of temperature, from 15° to 110°, from 6 to 115 per cent of sulphur, and above 110° to 130°, indefinite quantities of that metalloid. At temperatures ranging from 200° to 300°, sulphur decomposes the heavy oils, sulphuretted hydrogen being set free.

Les Mondes, June 17, 1869.

We notice from this paper, in the first place, the few, but interesting words written by the Rev. Father Secchi, S.J., to M. F. Mazco, at Turin—

On Electricity.—"I believe that the true theory of electricity will result from the principle that electricity is not a motion (*mouvement*), but a change of the quantitative and dynamic equilibrium of the ether which constitutes the atoms of the substances, and that the propagation of such a change is brought about by the moving of the ether from one atom to another; this motion shakes, disturbs the ether of the atoms, and thus produces heat."

Balances of Great Precision.—It appears that the celebrated physical instrument makers, Collot Frères, Paris, have greatly improved the mode of making balances, by devising what is called a balance on two columns. Without reproducing the woodcut contained in the above-named periodical, it is not easy to describe this instrument so as to be clearly understood by our readers; the system is an entirely new one, and by its application only is it possible to place the point of support on the axis of the balance, and thereby to shorten the length of the arms which bear the weight. Among the particulars mentioned of balances made according to this new system, we quote a balance made to bear, in each pan, 35 kilos., and sensitive with that load for 5 milligrms., and possessing, at the same time, perfect stability. Several balances of this kind have been made for the Russian Government; and the University of Upsala, Sweden, has two balances, each to carry 1 kilo. in each pan, and sensitive for 1½ milligrm. The laboratory of the School of Mines, Paris, has received, from MM. Collot, a balance of precision which, the author says, excels anything hitherto made. Balances with aluminium beams have also been introduced by these makers.

Among the acknowledgments of books received, we notice brief reviews of two small pamphlets, written and published in Italian, by the Rev. Father Secchi, S.J. The first of these books is entitled "*The Prismatic Spectra of the Heavenly Bodies.*" Contents—1st, the prismatic spectra of the fixed stars; 2nd, the catalogue of the stars of which the luminous spectrum has been determined; 3rd, description of the instruments applied in this investigation. The work is illustrated with beautifully-executed engravings, and is, according to the opinion of the reviewer in *Les Mondes*, an almost herculean labour, executed with a care and precision which might, at first sight, appear to be beyond the powers of one man. The other work is on "*The Nebula of Orion*," and is rather an astronomical essay.

Researches on the Propagation of Sulphuretted Hydrogen Gas through other Gases.—Dr. Hillebrandson.—The author of this memoir, originally published in Swedish, has made a series of experiments with sulphuretted hydrogen gas, because it is very readily detected, and its presence shown among other gases; these experiments fully confirm what is already well known on this subject.

June 24, 1869.

This number contains more information on the subject of the—

Oxyhydrogen Illumination.—L'Abbé Moigno.—This paper is written with the express view of meeting the objections made in public prints against this mode of procuring artificial light, and answers each objection completely. The first objection, made and refuted, concerns the alleged difficulty which oxygen is supposed to have, of passing readily through pipes, and travelling therein with ease, on account of its high specific gravity; the author states that experience has proved that, under the same, and, in all respects, identical conditions, oxygen gas travels more rapidly than hydrogen. Another point is an objection concerning the comparative rare occurrence of peroxide of manganese, and the difficulty of obtaining it; to this the reply is, there is plenty of manganese, of excellent quality, readily accessible, and more than fifty times as much as any greatly-increased demand will ever absorb; moreover, the oxygen is made from permanganate of soda, which, it appears, is revived again after having yielded its oxygen. One ton of this permanganate yields in twenty-four hours 100 cubic metres of oxygen; and, from reliable data obtained, 300 tons of the salt will suffice to produce yearly about 10,000,000 cubic metres of oxygen gas (a cubic metre is equal to 35·316 cubic feet). These 300 tons of permanganate are composed of 150 tons of soda, and 150 tons of peroxide of mangnese, an insignificantly small quantity, compared with the 60,000 tons which are consumed of this material annually. As to the too slow production of oxygen, the author says, at the oxygen gas-work, when in regular course of working, they have obtained, from each retort, 38 cubic metres of pure gas per day; as to the cost, he states that the gas-work intended to be established will cost, everything included (retorts, &c., gas-holders to hold 24,000 cubic metres of gas for twenty-four hours' supply, 32 kilometres' length of mains), 3,700,000 francs; as to the objection concerning the zirconia, or magnesia cones, these last for several days, and only cost one centime; at the same time, the glass chimneys and globes are dispensed with. As to the expense of this gas, it appears, from the statements of the author, that, taking into consideration the great quantity of light obtained, it is decidedly less expensive. The manufacture of hydrogen, by means of the patented process, from hydrate of lime, is, according to the author, very simple, and the pure hydrogen thus obtained costs less than two centimes per cubic metre, leaving even out of the question the sale of the by-products, which would not be trifling. Lastly, the author tells us that MM. J. Dumas (Senateur, &c.), Jamin, Balard, and H. Sainte-Claire Deville, all Members of the Institut; M. Debray, of the French Imperial Mint; and M. Alphand, Director of Public Rords and Promenades, have been appointed a committee, by M. Haussmann, Préfet du Département de la Seine, to inquire into, and minutely report upon, this subject in all its aspects and details.

July 1, 1869.

We learn from this number that M. Wurtz, of Paris, has been on an inspection journey to Germany, by order of the Minister of Public Instruction, to report upon the chemical laboratories of Germany, and to give his opinion as to the

progress of chemistry made in that country. The lengthy report of the eminent Doyen de la Faculté de Médicine of Paris may be summed up in these few words—That the material aid given to chemistry in Germany has developed that science there to a degree which it lacks in France, as well as in most other countries. It is not for want of zeal and industry, says the eminent *savant*, but for want of the material aid—good laboratories, plentifully supplied with all requisites—that we are behind, as compared with Germany.

Cyanide of Potassium in Blast Furnaces.—M. H. Pagot has made a series of experiments, on the large scale, at the blast furnaces of Randonnay, Département de l'Orne, and found that the fact announced now many years ago, by Messrs. Lyon Playfair and Bunsen, of the presence of cyanide of potassium in blast furnaces, is a reality, and that the salt is formed there in such large quantities that it might easily become a useful and plentiful by-product of ironworks.

Extension of Sulphuric Acid Manufacture.—M. Perret.—The enormous pyrites deposits of Chessy and St. Bel, France, are advantageously applied, by the owner of that mineral deposit, to manufacture, at five different sulphuric acid works, a quantity of no less than 100 tons of concentrated acid daily, exclusive of the simultaneous manufacture of a great many other chemicals, in the preparation of which sulphuric acid is used. The pyrites alluded to contains a sufficient amount of copper to make the extraction of that metal from the burnt pyrites a paying business. This mineral is largely exported from France into those places where it can be taken to at a remunerative price; the locality where the mineral is found is too far away from the sea or any readily navigable river thither to admit of its exportation being extended beyond the limits of localities on and near the Franco-Swiss and Italian frontiers.

The Journal of the Franklin Institute, May, 1869.

Among the Editorial Items and Novelties we meet with the following original communications:—

Invisible Light.—Prof. O. A Rood.—Many years since, the author says, a photograph was made, at Berlin, of the well-known bronze statue of the Amazon; and it was observed that, in the negative, a black streak occurred at the tip of the lance (held by the figure in an almost vertical position) while two other analogous marks appeared in other locations. This picture was sent to Prof. Dove (Berlin), whose investigations in connection with light are widely known, and he came to the conclusion that these markings might be due to electrical discharges going on from prominent points of the figure at the time the picture was taken, and which, though invisible to an observer, would, nevertheless, by reason of the high actinic power of electric light, produce an impression on the photographic plate. This conjecture has been fully confirmed by the author, who, in a series of ingenious experiments, proved that electric discharges, entirely invisible to the observer in the presence of daylight, might, nevertheless, produce images of themselves in a picture of the adjacent objects taken at the same time, the photographic plate being relatively more sensitive to these impressions than the human eye. The author describes at length his mode of experimenting; but, without a reproduction of the woodcuts illustrating this paper, it is not possible to enter into more details on this subject.

New Arrangement of the Holtz Machine.—Prof. Smith.—In the ordinary mode of excitation of the Holtz machine, the knobs of the dischargers are placed in contact, and afterwards separated; the excitation cannot be produced without contact. It follows, that, when the balls are separated beyond the striking distance, all action will suddenly cease, and, to renew it, the balls must again be brought together; and frequently, in addition to this, a new excitation of the sectors will be required. A large class of electrical experiments require, virtually, this separation of the balls beyond the striking distance—*e.g.*, the "electrical flyers," the "head of hair," and the insulating stool. The author fully explains his arrangement, so as to keep up an unlimited excitation, whatever be the number of points applied to the prime conductor, or whatever may be the distance of the balls of the dischargers; and, in order to excite the machine, it is not necessary that the balls should be in contact. We cannot, without woodcuts, give more details from this paper.

The greater part of the remaining papers of this number treat on matters of engineering, or are reproductions from papers found in European periodicals, among which the Chemical News occupies a prominent place.

Moniteur Scientifique, No. 300, June 15, 1869.

The greater part of this periodical is occupied with translations of papers taken from English and German periodicals already noticed by us. Among the original papers relating to natural sciences, excluding physiology, medicine, and natural history, we meet with a paper—

On the Rotatory Equivalent of Cane Sugar and Rock Crystal in their bearing upon Optical Saccharimetry.—M. Dubrunfaut.—The author states that the figure, 16·471 grms., which in the year 1850 was adopted as the correct unit for optico-saccharimetrical experiments, is wrong, and has been afterwards altered to 16·350 grms.; he next adduces, as proof of the necessity of a revision, also, of that last figure, some experiments of his, recently made with samples of sugar kept as standards at the French Ministry of Commerce. The author further alludes to the impurities of refined sugar as the cause of these errors, and finally states that, when a really well-made optical saccharimeter is used, and pure sugar, the figure 15·976 grms. represents truly the absolute rotatory equivalent of rock crystal as well as of pure cane sugar. The author quotes the results of an analysis of refined sugar, purified by him, by means of pure absolute alcohol, as follows, in 100 parts:—Ash, 0·00039; water, 0·00030; glucose, 0·00018; and traces of lactic acid. It appears, however, that M. Dubrunfaut is entirely unacquainted with the extensive series of experiments made on this subject in the Netherlands by Profs. G. J. Mulder, P. Harting, and F. C. Donders, and at Breslau by Dr. Duflos and M. Schloesser.

Among the subjects of *brévets d'invention*, we notice—

A Process of Preserving the Yolk of Eggs, patented by M. D'Andiran-Kœchlin, consisting in adding to the previously-broken-up yolks of eggs (the white being entirely separated and applied for the purposes of calico printing), after having been dried, from 3 to 5 per cent of common salt, and one part per 1000 of arsenious acid. This yolk is not intended for food, but for the glove and wash-leather making factories; it is kept in air-tight vessels, filled without leaving any air whatever inside, and a couple of drops of puro carbolic acid are added to every litre of this homogeneous fluid.

To three gentlemen, has been granted a *brévet* for—

The Extraction of Benzine and its Homologues from Illuminating Gas obtained from Coals.—The precise process is not described; but, although it is certainly true that illuminating gas contains, by weight, ten times as large a quantity of benzine as does the coal-tar obtained at the same time, it is equally true that this benzine cannot be withdrawn from gas intended to serve the purposes of yielding good artificial light without greatly injuring its qualities in that aspect.

Improved mode of Manufacturing Glucose from Starch.—M. Maubré.—The author states that, by the usual mode of proceeding, a portion of the starch is always left in the state of dextrine; he therefore operates under pressure and a higher temperature. For this purpose, he applies a strong cylindrically-shaped iron vessel, internally lined with lead: this boiler is charged with 28 kilos. of sulphuric acid, at 60° Beaumé, and 2800 litres of water, and this liquid is

brought to the boiling point by means of high pressure steam. When boiling, there is gradually run into this fluid a mixture of 1180 kilos. of starch and 2500 litres of water, acidulated with 28 kilos. of sulphuric acid. When the whole of this quantity has been introduced into the aforesaid boiler, it is closed, and the temperature within it raised to 160°, by means of high pressure steam introduced into the boiler by leaden and perforated pipes. After about four hours, the action is complete, the fluid run off into tubs, and the acid saturated by means of 84 kilos. of finely-powdered good limestone. After separation of the sulphate of lime, the fluid is evaporated to 20° B., clarified with animal charcoal, and next evaporated in vacuum pans, yielding an excellent and beautiful glucose.

No. 301, July 1, 1869.

The only original paper contained in this number, is on the—

Platinizing of Looking-Glasses.—M. Jouglet.—This paper, a very verbose and lengthy dissertation on a comparatively-speaking very trivial subject, appears to have been written with the view to bring forward a peculiar kind of manufacturing process, which, if it is attended with any improvement at all, will receive, no doubt, full justice at the hands of the public, who may be trusted to distinguish whether the covering the back of plate-glass with a thin layer of platinum is an advantage over the silvering, or amalgamating, generally applied for this purpose. The process itself does not seem to contain any novelty, and is described in this paper in a tediously-puffing style.

Cosmos, July 3, 1869.

New Dye from Madder.—Prof. Rochleder, at Prague, has found that, when madder is treated with dilute mineral acids, it yields, beside alizarine and purpurine, a small quantity of a third tinctorial substance, which, in alkaline solution, has a great similarity to chrysophanic acid dissolved in alkaline solution; acids precipitate it from this solution in the amorphous flocculent shape, the precipitate being of a pale yellow colour. This substance is soluble in alcohol and in acetic acid, and crystallises from these solutions, on the evaporation of the solvent, yielding orange-yellow coloured crystals; its aqueous solution mixed with acetic acid, and brought to boiling point, imparts to silk and wool immersed in that bath a beautiful and durable golden-yellow colour.

July, 10, 1869.

This paper contains, as usual, a variety of information. The only note suitable for our readers is—

On the Seat of the Hygroscopic Properties of Silk.—M. Suida.—It is a well-known fact that crude silk is very hygroscopic; and some doubt has existed as to whether the exterior gum-like varnish of the raw silk, or the interior fibroine, was the chief seat of this great avidity for moisture. The author has taken a certain quantity of one and the same kind of silk (the avidity for moisture is by no means the same for all silks the produce even of one and the same country, and therefore it was necessary to operate upon one sample of known and the same origin), a portion of which had been deprived of its natural gum, while another portion was in its native state. The results of very carefully instituted experiments is, that the fibroine—that is to say, the essential fibre of the silk itself, and not its tegumentary parts, gum chiefly, are the seat of the hygroscopic properties of raw non-dyed silk; the process of dyeing materially altering the fibre, also affects its hygroscopic properties. In 100 parts of silk, according to Mulder's analysis, the only extant, this substance consists of:—Fibroine, 53·37; gelatine, 20·66; albumen, 24·43; wax, 1·39; yellow colouring matter, 0·05; resinous and fatty matters, 0·10; this analysis refers to yellow (naturally coloured) silk from Naples. White native silk from the Levant was composed, in 100 parts, of—Fibroine, 54·04; gelatine, 19·08; albumen, 25·47; wax, 1·11; resinous and fatty matters, 0·30.

Bulletin de la Société Chimique de Paris, June, 1869.

From the *procès verbal* of the meeting of this society, held on the 16th of April last, we quote the following:—

M. Lefranc, a pharmaceutical chemist of the French army, presented to the Society a printed pamphlet—

On Atractylic Acid and Atractylates.—This acid is a naturally-existing compound sulpho-acid, met with in the *Atractylis gummifera* as a potassa salt; it is split up, by the action of acids, into sulphuric and valerianic acids, glucose, and a resin.

M. Tollens stated at the meeting that the well-known reaction of hypochlorite of lime and aniline is interfered with by the presence of ammonia, or any salt thereof, and that then the reaction only takes place when a large excess of chloride of lime is applied.

The following original papers are published in this number:—

Action of the Electric Spark upon Marsh Gas.

Direct Union of Free Nitrogen and Acetylene, and the Direct Formation of Hydrocyanic Acid.

Both these papers having been read by the author, M. Berthelot, also at meetings of the Académie des Sciences, have been already noticed by us; this remark equally applies to the next paper, by the same author—

Formation and Decomposition of Sulphide of Carbon.

Chemical Equilibrium, and the Influence of Pressure as Affecting the Action of Carbon and Hydrogen upon each other.—M. Berthelot.—The chief result arrived at by the author is that, when the pressure varies continuously, the equilibrium between carbon and hydrogen changes by sudden shocks, thereby following rapports which are the multiples of the one and the other.

Essence of Sassafras.—Messrs. Grimaux and Ruotte.—The essential oil of sassafras, obtained from the *Laurus sassafras*, is, when recently rectified, a colourless fluid, which, at 0° C. (32° F.), has a specific gravity of 1·0815. The oil is a mixture of a hydrocarbon and an inactive oxygen-containing principle; this latter consists, in 100 parts, of—Carbon, 74·43; hydrogen, 6·46; oxygen, 19·11. It is present in the natural oil in so small quantity that only just sufficient for a good elementary organic analysis was obtained. The hydrocarbon (safren) contains $C_{10}H_6$, and consists, in 100 parts, of —C, 88·23; H, 11·77. Its vapour density has been found equal to 4·84. Safren boils at about 156°. The oil further contains safrol, $C_{10}H_{10}O_2$, boiling at between 231° and 233°. Safrol is insoluble in water. Its specific gravity is 1·1141 at 0°; at —20° it is not frozen. The authors have studied the action of bromine, of hydriodic acid, of perchloride of phosphorus, and nitric acid upon safrol, but state that none of these reactions gave such results as they expected. With bromine, safrol yields a compound of the formula $C_{10}H_5Br_5O_2$.

Presence in the Air of Active Oxygen, or Ozone.—M. Houzeau.—The author demonstrates, at great length, in this paper that the air of the country is of a different character from that of towns; that the former is strongly disinfectant, has far greater bleaching power, and, especially after rainfall, affects bright and oxidisable metals far more than is the case in towns. This paper is not intended as a fully-demonstrative memoir, but in it the author calls attention to some facts readily observed, as, for instance, the rapid bleaching of all kinds of woven fabrics, be they made of linen, cotton, or woollen fibre; the rapid fading of very many dyed tissues; the far more active rusting of iron, steel, and even copper, in the country as compared with large towns. Curiously enough, the author does not mention the well-known fact of the effects of the air at sea, even at comparatively short distances from the shore, nor, also, the peculiar effects produced by the mountain air at no greater height than from 2000 to 6000 feet above sea-level.

Bromide and Iodide of Propionyl.—M. Sestini.—The specific gravity of the bromide of propionyl is, at 14°, equal to 1·465; its boiling point is about 97°; water decom-

poses it; formula, C_3H_5OBr. The iodide of propionyl boils at 127°; its specific gravity is far greater than that of water, in contact with which it is decomposed instantaneously; formula, C_3H_5OI.

Soluble Albumen which is not Coagulated by Heat.—Dr. Monnier.—We have already noticed this communication, but have to rectify the name of the author's place of residence, which is not *Lyons*, but *Nyon* (a town in the Département de Drôme); the *Deutsche Industrie Zeitung*, from which our abstract was made, had printed *Lyons*.

Use of Phosphate of Soda for Removing Manganese out of Solutions wherein Zinc has to be Estimated Volumetrically.—M. Renard.—The author states that he dissolved 1 grm. of zinc in hydrochloric acid, added thereto 0·6 grm. of chloride of manganese; next ammonia was added, and after that phosphate of soda; the result of his volumetrical estimation of zinc in this solution came to 0·998 grm. of zinc. When the addition of phosphate of soda to a solution of precisely the same composition as the one alluded to was omitted, the quantity of zinc was found to amount to 1·036 grm. The ferrocyanide of potassium process was used in these experiments.

The remaining pages of this periodical are filled with abstracts and translations from English, German, and American periodicals, and with abstracts from the *Comptes Rendus*. The large majority of these are taken from works published during the course of last year; most of them have been already noticed by us.

Journal für Praktische Chemie, No. 6, 1869.

This periodical opens with a very lengthy and exhaustive essay on the

Affinity between Solution of Acetate of Iron without Change of State of Aggregation.—Prof. A. Müller.—This memoir is subdivided into several chapters, and has a series of tabulated forms added: it is not well suited for abstraction.

Chemical Researches of the Eozoon Stone at Raspenau, in Bohemia.—Dr. R. Hofmann.—The stone here alluded to appears to be a serpentinoid mineral, embodied in a kind of dolomite, of which the composition, in 100 parts, is as follows:—Carbonate of lime, 58·815; carbonate of magnesia, 40·20; peroxide of iron, 4·291; insoluble in HCl, 1·261; water, 0·083; traces only of phosphoric acid. The shell of the eozoon stone consists, in 100 parts, of—Carbonate of lime, 97·711; carbonate of protoxide of iron, 1·660; carbonate of magnesia, a trace; alumina, 0·629; minute traces of phosphoric acid. The central portion of the inner part of the eozoon stone has a specific gravity of 2·687, and consists, in 100 parts, of—Water, 7·092; silica, 36·425; alumina, 32·944; protoxide of iron, 20·140; lime, 0·678; potassa, 2·721.

Dolomitic Limestone of Cheynov, near Tabor, in Bohemia.—Dr. R. Hofmann.—This limestone is deposited among and embedded in gneiss; it varies in composition as well as in specific gravity, the latter having been found as low as 2·711, and as high as 2·861; its extremes of composition, in 100 parts, are as follows:—Carbonate of lime, 98·418, and 57·809; carbonate of magnesia, 0·009, and 39·186; protoxide of iron, 0·346, and 0·628; peroxide of iron and alumina, none in either sample; insoluble in hydrochloric acid, 1·167, and 2·377.

Composition of Hauyn.—Prof. A. Kenngott.—This is a purely mineralogical paper.

Basic Salts of Zinc and Copper.—M. Franz Reindel.—The author says that, when a boiling solution of sulphate of zinc containing an excess of that salt is treated either with a solution of caustic or carbonated alkalies, precipitates are formed which, both in consequence of their composition and of their peculiar behaviour towards reagents, deserve the attention of chemists. It has often been stated that pure $CuOCO_2$ may be obtained by decomposing 1 equivalent of $CuOSO_3$ with 1 equivalent of $NaOCO_2$. The author has digested the mixture obtained as result of this reaction for one month with a concentrated solution of soda in the cold, and has not been able thus to obtain, even after very careful washing out, a product entirely free from sulphuric acid. The basic sulphate of zinc obtained by boiling a solution of sulphate of zinc in excess with ammonia constitutes a white powder, which, on being washed with water, is steadily but very slowly decomposed; the fluid running off from the filter has an acid reaction, and contains sulphuric acid as well as oxide of zinc. The author gives, in this lengthy and still unfinished paper, several analyses of basic salts, obtained under a variety of conditions, and dried at temperatures varying from 110° to 260°, whereby the quantity of water of these salts is reduced, but not eliminated, for some of these salts lose water up to a red heat.

Influence of Water upon some Siliceous Minerals.—M. A. Cossa.—The minerals submitted to experiment were two kinds of gneiss, syenite, several kinds of trachyte, granite, and basalt. They were reduced to powder, and left for ten days in contact with twenty-five times their bulk of pure water, at a temperature of from 17° to 18°, the filtrates were evaporated to dryness, and, after having been moistened with hydrochloric acid, again evaporated, and the dry residue weighed as chlorides. The weight of these residues varied from 0·0567 per cent to 0·35 per cent of matter dissolved.

Annales de Chimie et de Physique, April, May, and June, 1869.

We do not separately notice each of them, for the reason that the last essay which concludes the number for May is continued through that of June, but not yet concluded.

The April number of this periodical opens with a portion of M. Friedel's essay on the **Acetons and Aldehydes**, which is concluded. Next we meet with a biographical notice of M. Sadi Carnot, by Le Comte Paul de Saint Robert. Next follows—

Researches on Resins.—M. Sacc.—The author observes that resins have been very little studied at all; and his researches recorded in this paper extend to copal, amber, dammar, colophony, lac (or shellac), elemi, sandarac, mastic, and carnauba wax (a resin). The author has studied the more or less degree of readiness wherewith resins are reduced to powder, the action thereupon of boiling water, of alcohol of 86 per cent strength, of ether, of ordinary acetic acid, of a hot solution of caustic soda of 1·074 specific gravity, of sulphide of carbon, of oil of turpentine, of boiled linseed oil, of benzine, of naphtha, of sulphuric acid of 1·83 specific gravity, of nitric acid of 1·329 specific gravity, and of caustic ammonia. All resins were applied in powdered state; and the solvents three times as large a bulk as that of the resins have acted for at least twenty-four hours, at temperatures varying between 15° and 22°. The general results arrived at are briefly as follows:—All resins submitted to experiments fuse quietly when heated, excepting amber, shellac, elemi, sandarac, and mastic, which swell up, and increase in bulk. Only the carnauba wax melts in boiling water; colophony becomes pasty therein, while dammar, shellac, elemi, and mastic agglutinate. Copal, amber, and sandarac do not change. Alcohol does not dissolve amber nor dammar; agglutinates copal, partly dissolves elemi and carnauba wax; while colophony, shellac, sandarac, and mastic are readily soluble therein. Ether does not dissolve amber and shellac; makes copal swell, and partly but slowly dissolves carnauba wax; dammar, colophony, elemi, sandarac, and mastic are readily dissolved therein. Acetic acid does not dissolve amber and shellac; causes copal to swell; somewhat acts upon carnauba wax, and does not at all act upon any other of the resins above named. Caustic soda solution readily dissolves shellac, difficultly colophony, and has no action upon the rest. In sulphide of carbon, amber and shellac are insoluble; copal

swells therein; elemi, sandarac, mastic, and carnauba wax are difficultly dissolved therein, while dammar and colophony are readily so. Oil of turpentine has no action upon amber or shellac; causes copal to swell up; dissolves readily dammar, colophony, elemi, sandarac, carnauba, and very readily mastic. Sulphuric acid does not dissolve carnauba wax; all other resins are dissolved and coloured brown, excepting dammar, which becomes bright red. Nitric acid does not act upon the resins, but colours carnauba wax straw-yellow, elemi a dirty yellow, and mastic and sandarac bright brown. Ammonia does not dissolve some of these resins, but causes copal, sandarac, and mastic first to swell, afterwards dissolving them; colophony is easily soluble therein.

Researches on the Composition and Structure of Meteorites.—M. S. Meunier.—A very interesting and elaborate essay on this subject, but too long for proper abstraction.

On a Pump provided with a Free Plunger (*pompe à piston libre*).—M. le Marquis de Montrichard.—A physico-mechanical paper.

Pyro-Electric Properties of Crystals which are Good Conductors of Electricity.—M. C. Friedel.—The abstraction of this paper, without the re-production of the large number of woodcuts essentially belonging thereto, would be useless.

Nitrites of the Fatty Acids.—M. A. Gautier.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, April, 1869.

We notice the following original papers:—

On Cytisin, an Alkaloid of the Genus Cytisis.—Dr. A. Husemann.—The seed, bark, and root of the well-known laburnum tree (originally from Switzerland, but now dispersed throughout Europe), *Cytisus laburnum*, L., contains, it appears, an alkaloid, which has been isolated by the author, and is described by him as a white crystalline solid substance, of bitter and somewhat caustic taste, soluble in water and alcohol, and hardly soluble at all in ether, chloroform, benzol, and sulphide of carbon. Cytisin is a strong basic substance, precipitating many metallic combinations from their solutions, and setting free ammonia from its compounds. Its composition, in 100 parts, is:—C, 73·84; H, 8·30; N, 12·92; O, 4·94; formula, $C_{20}H_{27}N_3O$. The nitrate of cytisin is a readily-crystallisable salt.

The other original paper is one belonging strictly to botany. Among the miscellaneous papers met with in this periodical, we meet with a communication—

On the Varieties of Tapioca and Sago Prepared in the Malaccas.—It appears that, at the request of the resident Governor of the Malacca Islands, researches have been instituted concerning this food, at the Laboratory, at Welte Vreden, Java. The authors of this paper, MM. Maier, Moens, and Scharlec, found that three varieties of sago, denominated white, red, and blue, contain, respectively—water, 16·14, 18·83, and 18·47 per cent; protein compounds, respectively—3·7, 2·5, and 2·4 per cent; starch, fat, &c., respectively—79·88, 78·06, and 78·15 per cent; ash, respectively—0·22, 0·52, and 0·94 per cent.

The remainder of the miscellaneous in this number are of no special interest to our readers.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 137, May, 15, 1869.

The original papers of this number of this periodical are confined to—

A Note on the Aurora Borealis of the 15th of April, 1869.

On Berberis Vulgaris.—M. Schnetzler.

Experimental and Theoretical Researches on the Equilibrium Figures of a Liquid Mass not Possessed of any Weight.—M. Plateau.

No. 138, June 15, 1869.

This periodical contains an astronomical paper, unsuitable for abstraction here, and no other original papers; being filled with translations of memoirs taken from *Poggendorff's Annalen*, and other periodicals of that description, the papers having been alluded to and quoted by us already.

Chemisches Centralblatt, No. 20, May 19, 1869.

This number does not contain any original papers or communications.

Bayerisches Industrieund Gewerbeblatt, March and April, 1869.

The greater part of this double number is filled with "Dasr Berggesitz für das Königreich Bayern"—that is to say, a very lucidly and perfectly-made law (act of parliament) for the regulation of everything connected with mining, quarrying, and the extraction, from the earth, of minerals, including coal, limestone, and also building materials, &c., for the kingdom of Bavaria.

Boring of Wells, and the Water Supply to Large Towns.—M. Kieser.—This is a rather lengthy, but highly interesting, essay, on a subject of very great importance.

Experiments on the Bleaching of Wood Pulp for Paper Manufacture.—Dr. C. Winkler. — Neither chlorine, bromine, nor any substances the activity of which is due to oxidation, were found by the author to answer the purpose, the result always being the production of a decidedly yellow, and sometimes even brown, tinge. Sulphurous acid does not completely answer the purpose; the destruction of the natural colouring matters by means of fermentation did not lead, also, to any good result.

Effect of Temperature of the Air upon the Illuminating Power of Burning Coal Gas.—M. A. Vogel.—From this lengthy essay we only notice that, when the illuminating power of ordinarily good coal gas is equal to 100 at 18°, it is only 76 at 0° and 33 at —20°.

May, 1869.

This number chiefly contains officially-published matter, among which are very minute directions for the assay of gold and silver articles of *bijouterie* and the use of proof or touch needles in testing the quality of pure gold and silver contained in articles presented for assay to the parties appointed for this purpose; all such assayers have to pass a very strict examination in general and practical chemistry, and especially in the assay of gold and silver by the dry, and also the wet process, as far as the latter metal is concerned. The touch-needles alluded to are made at the Munich mint, uniformly for the seven assay districts into which the kingdom of Bavaria is divided. This number does not contain any original papers relating to chemistry, or sciences closely related thereto.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, March, 1869.

This number of this periodical, which is always rather behind-hand as regards its time of being published, does not contain any memoirs or papers which bear upon chemistry, or sciences closely allied thereto.

Annales des Mines, vol. xv., 1st part for 1869.

This periodical contains—

A Biography of the Chemist, P. Berthier.—A concise review of his arduously-accomplished and incessant labours. This lengthy paper is concluded by an enumeration of the titles of the memoirs, papers, and books published by this *savant*, which catalogue occupies no less than fourteen octavo pages, printed in small type.

Although not belonging to the subjects usually treated by us, we cannot refrain from calling attention here to an excellent report on a steam boiler explosion, which took place at Moulins-Lille.

The rest of the papers in this number of this periodical bear upon practical mining, and are not of general importance.

Revue Universelle des Mines, de la Métallurgie, des Travaux Publics des Sciences et des Arts Appliqués a l'Industrie,

Nos. 1 and 2 for 1869.

This very useful periodical is published in Belgium, and its editors are Belgians of high scientific as well as practical attainments. The first paper we meet with in this number is an excellent monograph on the—

Mineralogical Character and the Mineral Value of the Iron Ores of the Province of Luijk (Liege).—M. Franquoy.—From among the large number of analyses which accompany this very lengthy paper, we quote the analyses of a couple of samples of *fer-carbonaté lithoide des houillères*. The first sample contains, in 100 parts:—Carbonate of iron, 73·66; carbonate of lime, 2·98; carbonate of magnesia, 2·06; carbonate of manganese, 3·31; clay, 12·17; water and carbonaceous matter, 5·53; phosphoric acid, 0·29; yield of metallic iron, 34·76 per cent; specific gravity of this sample of ore, 3·15. The other sample contains, in 100 parts:—Carbonate of iron, 56·23; carbonate of lime, 4·84; carbonate of magnesia, 2·93; carbonate of manganese, 0·58; clay, 26·20 water and carbonaceous matter, 9·22; phosphoric acid, a trace; yield of metallic iron, 26·96 per cent; specific gravity of this sample of the mineral, 3·123.

On Saccharimetry.—This paper is a magnificent monograph on this subject, being the result of researches instituted in consequence of the International Convention agreed to by France, the United Kingdom, the Netherlands, and Belgium, on the 8th of November, 1864, in reference to the rules which shall apply to the amount, and mode of payment, of the duties on sugar in these four countries. The paper here alluded to is chiefly the work of Prof. Landolt, of Bonn, and is published by the kind permission of His Excellency the Belgian Minister of Commerce; we regret that it is too full of interesting matter, too concisely written, and, moreover, by far too lengthy for any useful abstraction. As a curiosity rather, and as proving the correctness of the figures adopted by the Netherlands Society of Commerce—whereby raw sugars are designated by the cypher-figures 1, 2, 3, and so on up to 21, according to the degree of purity, and the higher percentage of crystallisable sugar contained in the various samples so designated—we quote the following analysis:—No. 9, in 100 parts—Pure cane sugar, 89·6; organic salts, 4·3; water, 3·8; undetermined substances, 2·3. No. 12, in 100 parts—Pure cane sugar, 93·0; organic salts, 3·7; water, 3·1; undetermined substances, 0·2. No. 15, in 100 parts—Pure cane sugar, 95·0; organic salts, 1·6; water, 2·0; undetermined substances, 1·4 The composition of treacle, in 100 parts, varies between the following limits: Best sample contained—Cane sugar, 61·8; sucrose (*sucre interverti*), 1·9; salts, 18·9; water, 14·2; undetermined substances, 3·2. Worst sample contained—Cane sugar, 54·4; sucrose, 1·6; salts, 19·9; water, 21·0; undetermined substances, 3·1. All the experiments were made on samples taken from quantities several thousand kilogrammes in weight, and they were performed at Cologne, in the establishment of the Rheinischen Actions Verein für Zuckerfabrikation, one of the largest and best-conducted sugar refineries in the world.

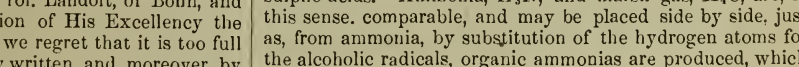
Observations on M. Marguerittе's Process of the Volumetrical Estimation of Iron.—M. Léon Moyanx.—This paper ends with the following concisely-stated conclusions, arrived at by the author as result of his experiments:—1st. The normalisation of the permanganate solution can only be properly made by means of metallic iron, and, when the latter metal, in sufficiently pure state for this purpose, does not happen to be at hand, by means of oxalic acid (indirect titration). 2nd. The use of ammonio-sulphate of iron should be rejected; unless, indeed, the precise composition of this salt is repeatedly ascertained, it is not to be relied on, and this testing is a loss of time. 3rd. Repeatedly-continued research is required to ascertain that the solutions of *proto*-salts of iron really keep and continue to be so. 4th. The evaporation of solutions of iron containing hydrochloric or other volatile acids, after the addition of sulphuric acid, always impairs the result of the titration. 5th. The reduction of solutions of *per*-salts of iron to *proto*-salts, after driving off excess of hydrochloric acid, is best effected by means of zinc, better yet by means of amalgamated zinc; but this last metal is to be rejected when a solution of iron happens to contain, at the same time, a proto- and a persalt. 6th. When 0·3 grm. of ore is taken for assay, in case the ore should contain more than 40 per cent of metallic iron (or, when less than that quantity, 0·5 grm. is taken for assay), the quantity of fluid best suited to yield accurate results should not, in either of these cases, respectively exceed ½ or ¼ a litre.

The other papers of this periodical relate chiefly to mechanical engineering and machinery.

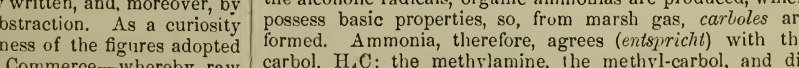
Chemisches Centralblatt, No. 21, May 26, 1869.

The larger part of this paper is occupied with a treatise on the—

Chemical Constitution of the Organic Hydrocarbons.—M. Kolbe.—The author of this lengthy treatise begins by stating that, however ingenious M. Kékulé's theory may be, that theory is, after all, a failure, and in every respect erroneous. The author next states that, according to his opinion, a solid basis for speculation, on the true constitution of the organic hydrocarbons, is to be deducted from cur experience with organic ammonias. The comparison of these two kinds of compounds has made clearly understood to him the nature of di- and tri-carbon acids, in reference to mono-carbon acids; and the organic ammonias, wherein nitrogen and phosphorus equivalently act, are the counterpart and example for the mode of constitution of the carbo-sulpho-acids. Ammonia, H_3N, and marsh gas, H_4C, are, in this sense. comparable, and may be placed side by side. just as, from ammonia, by substitution of the hydrogen atoms for the alcoholic radicals, organic ammonias are produced, which possess basic properties, so, from marsh gas, *carboles* are formed. Ammonia, therefore, agrees (*entspricht*) with the carbol, H_4C; the methylamine, the methyl-carbol, and di- and tri-methylamine agree with the di- and tri-methyl-carbol.



Ammonia. Methylamine. Dimethylamine. Trimethylamine.



Carbol. Methylcarbol. Dimethylcarbol. Trimethylcarbol.

The learned author proceeds, in this manner, with his essay, proving, by a great variety of instances, the truth of his statement; his paper is, however, not well suited for abstraction, and the less so from the fact that, in the above-named periodical, a condensed abstract only is published.

Reduction of Carbonic Acid to Oxalic Acid.—M. E. Drechsel.—Pure and clean sodium, exhibiting a metallic surface, is placed, along with some freshly-ignited quartz-sand, into a clean flask, and a rapid stream of carbonic acid gas is passed into the flask, which, at the same time, should be heated to the temperature of boiling mercury, 662° F. The sodium molten at this temperature yields, on being stirred up with a glass rod, a silvery semi-fluid paste. As soon as the reaction sets in, the metal assumes a purple color, and, after a few hours, is converted into a dark pulverulent mass. Too much heat should not be applied; and, especially towards the end of the operation, great care is required in managing it, since a too high degree of temperature may cause the combustion of the newly-formed product. After having cooled in the flask, the substances therein contained are withdrawn from it, and, having been spread out in a thin layer, so as to effect the oxidation of any small par-

ticle of sodium not yet acted upon, the mass is exhausted with water, the aqueous solution saturated with an excess of acetic acid, and, after having been filtered, precipitated with chloride of calcium; the precipitate thus formed is always rather brownish coloured. It is dissolved in hydrochloric acid, filtered while yet hot, and precipitated with ammonia, whereby the salt, oxalate of lime, is obtained perfectly snow-white; 60 grms. of sodium yield, by this process, 6 grms. of pure oxalate of lime. Instead of sodium, a potassium-amalgam, containing 2 per cent of the alkali metal, and otherwise treated in the manner just described, yields a fair percentage of oxalate of potassa.

Nos. 22 and 23, June 2 and 9, 1869.

These two numbers do not contain any original memoirs, papers, or communications.

Bulletin de l'Academie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 4, 1869.

The only treatise contained in this number relating to chemistry is the first portion of an essay on the—

Isomerism of the Salicylic Series.—M. L. Henry.—The first section is headed—*Chlorinated Derivatives from Salicylic Aldehyde.* The derivatives of the *mono-substitués* of toluen and benzoic acid are pretty well known, and ought, according to this author, to be separated into three distinct groups, designated respectively—*ortho*, *para*, and *meta* series, each of these embracing a peculiarly characteristic monochlorinated benzoic acid, $C_7H_5ClO_2$, and a diatomic acid, $C_7H_6O_3$. The author also proposes to name each of the three groups already alluded to—the *benzoic*, or *oxybenzoic;* the *dracylic*, or *paraoxybenzoic;* and the *salylic*, or *salicylic* series. Of each of these series, a large number of very complex formulæ are given, but the paper, however interesting in a purely scientific point of view, is, on account of its length, and on account of the large space which the quotation of the formulæ would require, not quite suitable for further abstraction.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 9. May 23, 1869.

We notice the following original papers from this periodical:—

Contribution to our Knowledge of the Doubly Coupled (Gepaarte) Compounds of Inorganic Chemistry.—M. C. W. Blomstrand.—In the introduction to this paper, the author refers to a published work of his, to which the title "Die Chemie der Jetztzeit" (the chemistry of the present day) is given. Next, he states that, when explaining and settling the question about coupling, he mentioned some experiments of his on the behaviour of iodine towards yellow prussiate of potassa, which were not quite successful. The author next proceeds to review the ammonia compounds of platinum, and says that he considers the so-called platinocyanide of chloride of potassium, $2KCl+PtCy_4$, to be the perfect analogue of Grosses's base, which manner of viewing may be made evident by giving to the respective formulæ of these substances the following form:—Grosses's base—

$$(Cl—NH_3—NH_3)2\ Pt_4Cl_2;$$

platino-cyanide of chloride of potassium—

$$(K—Cy—Cy)2Pt_4Cl_2.$$

The author next proceeds to describe a lengthy series of researches on this subject, but his paper, an abstract of an abstract and *viva voce* communication by Dr. H. L. Buff, at the meeting of the Society, is too full of formulæ to be suitable for further abstraction.

On Binitro-Cresol.—MM. Martius and Wichelhaus.—There is met with in commere, under the name of Victoria yellow, or aniline orange, a reddish powder, which yields highly yellow-coloured solutions, and bears, in general, great likeness to the binitro-naphthol compounds. The authors have instituted some researches on this material, and have found it to be a nearly pure binitro-cresol salt. The binitro-cresol they separated from it is readily soluble in alcohol, ether, chloroform, and boiling water; it may be obtained in crystalline shape; the dry substance fuses at about 110° C.; the silver salt is rather difficultly soluble, and may be obtained in crystals. The authors have tried in vain to obtain, by the experimental method, a clue to the mode of manufacture and origin of this material. The solutions of binitro-cresol become gradually deep-red coloured on exposure to air, and also when chloride of iron is added to the same.

Some Derivatives from Phenylacetic Acid (a Toluylic Acid.—M. B. Radziszewski.—The author first describes the method whereby he prepared this acid; we need need not repeat this, as the author says it is well known, and is that used by Canizzaro. The methyl ether of this acid is a colourless liquid of 1·044 sp. gr. at 16°; it boils at 220°, without decomposition. The ethyl ether of the above-named acid is a liquid, having a sp. gr. of 1·031; it boils at 226°. The author next proceeds to describe the action of bromine upon the *a* toluylic acid; then the action of bichromate of potassa and dilute sulphuric acid; next, the action of chlorine, of nitric acid, and other chemicals; and winds up with saying—"The result of my researches is, that the *a* toluylic acid behaves with the haloids, and with nitric acid, as does toluol, giving rise, chiefly, to the formation of para products."

On the Pyromucic Acid Group.—M. Limpricht.—This paper could not be understood without the reproduction of the woodcut annexed to it.

Action of Sulphuric Acid upon Polychlorated Hydrocarbons.—M. A. Oppenheim.—When ethelyn-chloride is acted upon by sulphuric acid, at the ordinary temperature of the air, and at 100°, in sealed tubes, no action whatever ensues; at 130°, however, decomposition takes place, carbon is separated, sulphurous acid formed, and hydrochloric acid generated. When chlorobenzol, $C_6H_5.CHCl_2$, is mixed, at the ordinary temperature, with sulphuric acid, hydrochloric acid is given off without causing a colouration of the liquid; but, at 100°, complete decomposition sets in, and carbonaceous matter is deposited. A syrupy product of this decomposition may be obtained, exhibiting a fluid having a constant boiling point at 175°; its smell is akin to that of the essential oil of bitter almonds.

Constitution of Epichlorhydrin.—M. L. Darmstädter.—The author states that, according to his opinion, the formula of epichlorhydrin has to be written—

$$O\begin{matrix}CH_2Cl\\CH\\CH_2.\end{matrix}$$

Next, he mentions some experiments, in order to prove that the oxygen of epichlorhydrin is combined, by double affinity, to carbon, and is not present therein as hydroxyl To prove this, he states, at length, what action bromine and chloride of phosphorus exert upon substances containing hydroxyl; and then he gives an account of the action of these two chemicals upon epichlorhydrin. One of the results of this reaction is a liquid, which, in 100 parts, contains:—C, 15·22; H, 2·11; Cl, 15·01; Br, 67·65.

Constitution of the Native Combinations of Tantalum and Niobium.—M. C. Rammelsberg.—This paper is more of mineralogical than chemical interest; and, being an abstract from a large essay on this subject, is not well suited for further condensation.

On Dinitronaphthalin.—M. A. de Aguiar.—The author states that, when dinitronaphthalin is prepared from naphthalin, an isomer thereof is formed at the same time, which, being readily soluble in alcohol, may by that means be separated from the non-soluble variety. The variety soluble in alcohol the author calls *β* dinitronaphthalin; it is a crystalline solid substance, containing, in 100 parts:—C, 55·04; H, 2·75; formula, $C_{10}H_6(NO_2)_2$. The solutions of this substance become red on exposure to the atmosphere, and also on being treated with ammonia; treated with nitric acid, trinitronaphthalin is formed.

Annalen der Physik und Chemie, von Poggendorff, No. 4, June 1, 1869.

This periodical contains, as usual, a large number of original essays, for, in reality, the labours of the authors are rather essays than papers. The first we meet with is—

A Contribution to our Knowledge about Thunderstorms.—M. W. Bezold.—Although this is a meteorological subject, we call attention to this paper, in compiling which the author has made use of the records of insurance companies in Bavaria and Austria, and also of some local statistics collected in the towns and districts, and has applied these materials for the purpose of making a valuable essay on a subject which, as he rightly remarks, cannot be so well elucidated by the observations made at the meteorological observatories, these being too few in number and too far distant from each other. Between the years 1844 and 1865, no less than 1142 buildings, among the large number of those insured against accidents by fire, in Bavaria, were struck by lightning; this is in the proportion of forty-four buildings struck by lightning each year, upon 1,000,000 of buildings insured. The essay, from which we cannot abstract more, on account of its subject matter being foreign to the subjects treated of in our paper, deserves the attention of those whom it may concern in many respects.

On Leucitstone, as it occurs in a Peculiar Ore-Bearing Rock.—M. F. Zirkel.—This communication is a purely mineralogical essay, the subject of which is, beside, of local importance, only referring, as it does, to a single locality.

Certain Phenomenon of Refraction of Light first Observed by Quincke, and Changes of the Rays of Light during Total and Metallic Reflection.—M. E. Jochmann.—This, being an entirely mathematico-physical essay, is not suitable for abstraction.

Meteorites Deposited and Kept in Museums.—Dr. Buchner.—This is the fourth and concluding portion of a lengthy essay on this subject, compiled, in great measure, from previously published papers dispersed through a series of periodicals.

A Hitherto-Unobserved Electric Powder Figure.—M. Kundt.—The author, referring to the well-known Lichtenberg figures, caused by electricity when very finely-powdered substances, such as Lycopodium, are applied to an isolator, states that he has discovered a new kind of these figures, formed on a conducting surface, and less dependent than the Lichtenberg figures upon the peculiar kind of electric developer to be used. The author describes, at length, the various means by which he obtained these figures.

Determination of the Specific Heat of a Constant Bulk of Air by means of the Metallic Barometer.—M. Kohlrausch.—A mathematico-physical essay.

Trigonal Pyramid ξ on the Quartz from Baveno.—Dr. Becker.—A mathematico-crystallographic essay.

Composition of Hydrofluocerite. — M. Nordenskjold.—The author says this mineral, which contains fluoride and cerium, was discovered in the year 1838, at the Bastnäs quarry, near Riddarhyttan, Sweden, and then analysed by M. Hissinger. The author further states that, when he resumed the researches of this mineral, he found that its earlier investigators had made a mistake as to its containing water, of which it contains a mere trace; and, next, he records the mode of his researches of the mineral now named by him *hamartite*, from the Greek ἁμαρτω, to err. The result of his analysis is, that this mineral contains, in 100 parts:—Oxide of lanthanum, 45·77; oxide of cerium, 28·49; carbonic acid, 19·50; water, 1·01; fluorine, 5·23. Formula, $CeFl+2(LaO, CeO)CO_2$.

Grain Test for Bin-Axial Mica.—M. E. Rensch.—A crystallographical essay.

Discovery of Large Crystals of Quartz in a Very Difficultly-Accessible Portion of the Swiss Alps.—This paper is a reproduction from a newspaper published at Berne, and describes the cavern wherein these crystals were found; one of these weighs 267 lbs., is 69 centimetres in height, and has a circumference of 122 centimetres. This may suffice for this subject.

The editor of the *Annalen* very properly calls attention to a most useful work, now in regular course of publication under the auspices of the Prussian government—viz., the *Repertorium der Technischen, Mathematischen, und Naturwissenschaftlichen Journal-Literatur*. This most useful work, to which we may add the index of foreign scientific periodicals, will, as justly observed by the editor of *Poggendorff's Annalen*, keep the place of a permanent and periodically published supplement to the catalogue of scientific papers published by the Royal Society. The repertorium records the titles of the papers of some 150 periodicals, in all languages, and published over the whole world. It may be inspected at the Library of the Commissioners of Patents, where it is regularly taken in.

Annalen der Chemie und Pharmacie, June, 1869.

Contents:—

Action of Boiling Liquids containing Acids and Alkalies upon Glass and Porcelain Vessels.—Dr. A. Emmerling.—This essay, or rather monograph, contains the record of a series of most minutely-executed experiments, whereby to determine the influence of various fluids, containing acids, salts, and alkalies, upon vessels made of different qualities of glass and porcelain, in order to determine the amount of substance dissolved by such chemicals, and also by pure distilled water, and to ascertain what influence is thus exercised upon the accuracy of analysis and chemical researches in general. This monograph is full of interesting details, including analyses of glass. *En résumé*, its leading features are the following:—The action of boiling liquids, as specified above, upon glass vessels is proportionate to the duration of time of boiling; the action is proportionate to the surface which is in contact with the boiling fluid; the action is independent of the quantity of fluid which evaporates during a given time; the action decreases with the decrease of temperature of the solution; alkalies, even in dilute solutions, attack glass very strongly; acids generally act less than pure water, excepting sulphuric acid; among the salts, those act most energetically whose acids produce insoluble salts with lime—*e.g.*, sulphate and phosphate of soda, carbonate of soda, and oxalate of ammonia, the action of each of which increases with the degree of concentration of the solution; such salts as form, in water, readily-soluble lime-salts—for instance, the chlorides of ammonium, potassium, calcium, and nitrate of potassa—less strongly than pure water alone, and, with the greater degree of concentration of these salts, the action decreases. Bohemian glass stands acids better than the kinds of glass containing soda; the Berlin porcelain ware is only perceptibly acted upon by alkalies.

Researches on the Isomers of the Benzole Series (ninth monograph, containing "The Chlorinated Derivatives of Toluol.")—MM. Beilstein and Kuhlberg.—This essay is too lengthy for abstraction; the subject, moreover, has been already obstracted from another German publication

On Oxylohydroxamic Acid.—Dr. H. Lossen.—This acid is a solid substance, difficultly soluble in cold water; submitted to a higher temperature it is slowly decomposed; when suddenly heated to 105°, it detonates; boiling for a length of time with water does not decompose it; on being boiled with caustic potassa solution it is converted into oxalic acid: nitric acid decomposes it completely and very rapidly. This acid consists, in 100 parts, of:—C, 20·00; H, 3·33; N, 23·33; O, 53·34. Formula, $C_2H_4N_2O_4$. The author describes, at great length, a series of salts of the oxylohydroxamic acid.

Researches on Mesitylen (sixth series).—Some Newly-Discovered Derivatives of Mesitylen.—MM. Fittig and Hoogewerf.—This essay has been noticed by us already, since an abbreviated account of the subject herein referred to was published in another German periodical published previous to this number of the *Annalen*, and noticed by us.

Chemical Constitution of Glycerine and its Derivatives.—M. Kolbe.—The learned author of this monograph starts from the hypothesis that glycerine should be equal to—

$$\left.\begin{matrix} CH_3 \\ CH_2.HO_{11} \\ HO \\ HO \end{matrix}\right\} C;$$

and next states that glycerine contains the elements of two groups of methyl, constituted in the following manner:—

$$\left.\begin{matrix} CH_2.HO \\ CH_2.HO \\ H \\ HO \end{matrix}\right\} C, \quad \text{and} \quad \left.\begin{matrix} CH.(HO)_2 \\ CH_3 \\ H \\ HO \end{matrix}\right\} C.$$

The author then reviews such a lengthy series of compounds, and takes such extensive excursions over the immense field of organic chemistry that it is impossible to compress into a small space even a minute fraction of this monograph, to which, therefore, we will not allude any further, especially as it is more a philosophico-chemical dissertation on an abstruse subject than of direct practical application.

Journal für Praktische Chemie, No. 7, June 15, 1869.

The following original papers are found in this periodical:—

On Sanguinarin, its Properties and Composition.—M. Naschold.—Sanguinarin is so named because it is prepared from the *Sanguinaria canadensis*, but it also occurs in the *Chelidonium majus* and *Glauceum luteum;* it is an alkaloid, which, in pure state, is a crystalline, white-coloured solid; formula, $C_{17}H_{15}NO_4$. As a peculiarity, the author observes that the estimation of the nitrogen contained in this substance cannot be satisfactorily executed with the well-known soda-lime process, but has to be performed by Dumas's method. The author describes, at length, several combinations of sanguinarin with the chlorides and cyanides of platinum, its behaviour towards reagents, and its products of decomposition, but none of these are so precisely characteristic as thereby to render it easy to distinguish and detect sanguinarin from all other alkaloids.

Brandy obtained from Reindeer Moss.—M. Stenberg.—This paper contains, translated from a pamphlet published in Swedish, a more extensive account of a subject to which, some time since, we referred in our columns, and since it is of no importance, except where the *Cladonia rangifera* is found, we make no further abstract of this paper.

Estimation of Sulphur.—Dr. G. J. Mulder.—The author speaks of the estimation of sulphur in such substances which contain carbon and sulphur together, and are not very volatile, and are, at the same time, free from any ash or incombustible matter. A certain quantity of the substance wherein the sulphur has to be estimated is weighed off in a porcelain capsule; there is next added a weighed quantity of finely-powdered nitrate, or acetate of lead; next, some nitric acid, the strength of which depends upon the nature of the substance to be assayed; and, lastly, a few crystals of pure nitrate of ammonia are added. The contents of the porcelain vessel are now carefully evaporated to dryness, ignited, and weighed. Since the weight of the oxide of lead derived from the acetate or nitrate employed is known, the increase of weight of the capsule and contents is due to the sulphate of lead which has been formed from the sulphur originally contained in the substance submitted to experiment. This method also yields accurate results, when, besides sulphur, there may be iodine and bromine present, and also lead; the method may be used, also, for the estimation of phosphorus, when, in substances containing both that element and carbon, it is desired to estimate the former quantitatively, provided, of course, sulphur be absent.

Products of Decomposition of Legumin when Boiled with Sulphuric Acid.—M. Ritthausen.—The author states that, while he was engaged studying the products of decomposition of legumin and conglutin, he discovered a nitrogenous acid, which contained, in 100 parts:—C, 39·46; H, 6·14; N, 12·04; O, 42·36. This acid was called by the author leguminic acid. On resuming his investigations on this subject, he finds, as explained in this paper, that the acid just alluded to is a mixture of two amine acids—to wit, asparaginic acid, $C_4H_7NO_4$, and glutaminic acid, $C_5H_9NO_4$; both these acids are homologous—both are solid crystallisable substances, yielding, among their products of decomposition, by the action of nitric acid, malic and glutanic acids.

Gewerbsblätter für das Königreich Würtemberg, Nos. 5 and 6, 1869.

This periodical rarely contains anything but matters relating to applied mechanics and agriculture; in this number, however, we meet with a paper:—

On Cyanine.—M. Morat.—The author says that the colouring matter of flowers consists—1st, of cyanine, or a blue pigment; 2nd, a rose, or pink-coloured matter, in reality identical with the first, and only altered by an acidity of the juice; 3rd, two yellow-coloured matters—xanthine, insoluble in water, and xanthéine, soluble in that liquid. Cyanine is best prepared from the petals of violets or iris flowers; by exhausting these with boiling alcohol, a blue solution is obtained, which solution, however, soon turns brown, but is restored to its primitive colour by being shaken up in contact with air. In order to obtain the colouring matter in a pure state, the alcoholic solution is evaporated to dryness on a water-bath, and the residue taken up with water, wherein the blue pigment is soluble, while fatty matter and resins are left behind; the aqueous solution is precipitated by acetate of lead; the ensuing green-coloured precipitate is decomposed by sulphuretted hydrogen, filtered and washed, and the filtrate next evaporated to dryness upon a water-bath; the residue is exhausted with absolute alcohol, and the cyanine precipitated from its solution therein by ether. Cyanine does not crystallise, is soluble in water and alcohol, and insoluble in ether; acids turn it red, and alkalies green—it is a very highly sensitive reagent for both. Reducing agents decolourise cyanine; oxygen restores the colour. The red colouring matter of flowers is extracted in a similar manner, and, once isolated, exhibits characters identical with cyanine.

On Oenoline.—M. Morat.—Oenoline is the colouring matter met with in genuine red wines obtained from grapes; it is obtainable by treating the wine with basic acetate of lead; the ensuing precipitate is collected on a filter, washed, dried at 100°, and placed in a displacing apparatus, and while therein there is poured over the dry precipitate anhydrous ether, previously saturated with dry hydrochloric acid gas. There runs off a brown-coloured liquid; the precipitate is washed with anhydrous ether until what runs off ceases to have an acid reaction. The residue in the displacing apparatus, which now exhibits a bright red colour, is treated with alcohol of 36° Beaumé, which thereby assumes the same bright red colour. The alcoholic solution is concentrated by evaporation to a small bulk, and water is next added; this causes the colouring matter to precipitate as a red-coloured flocculent substance, insoluble in ether, very difficultly soluble in water, soluble in alcohol, and insoluble in benzol. By a long-continued boiling in water this colouring matter is changed, becomes brown, and loses its solubility in alcohol. The solution of the unaltered red pigment in dilute alcohol exhibits the following reactions:—Chlorine water and chlorine gas destroy the colour, producing thereby a yellow substance soluble in water; caustic potassa causes, first a blue, and next a brown colouration; lime-water yields a yellowish precipitate; bicarbonate of soda in aqueous solution, and aqueous solution of chloride of calcium, cause a blue colouration; solution of alum causes a brighter red colouration; hydrochloric acid effects no change; with nitric acid, a yellowish flocculent matter is thrown down; acetate of lead causes a blue precipitate; nitrate of lead produces a violetish red

precipitate; acetate of copper yields a chestnut-brown coloured precipitate. This red colouring matter is composed according to the following formula:—$C_{10}H_{10}O_5$. Young red wines contain, moreover, a pigment, soluble in acetic and butyric ethers, with a bluish violet colour, becoming green by ammonia, and finally turning brown. Some chemists consider that this material is identical with cyanine; it is not a very stable compound, and is only met with in young wines. The colouring matter of wine is of some interest, as affording a means for detecting adulterations and artificial substitutes of wine.

Polytechnisches Journal von Dingler, second number for May, 1869.

Among the original papers, other than those relating to mechanical art and purely practical engineering, we meet here with a lengthy essay on the—

Conditions which are required for the Formation of Hypochlorite of Lime.—MM. Tschigianjanz, Fricke, and Reimer.—The authors, who have most thoroughly investigated this subject, begin their essay with the statement that, in practice, as well as in theory, a real influence has been ascribed to the moisture and state of hydration of the slacked lime which is submitted to the action of the chlorine gas; next, they review the opinions and labours on this subject of MM. Weisz, Morin, and Houton-Labillardière, Dr. Ure, Dr. Muspratt, Prof. T. Graham, and, lastly, Dr. Bolley. Curiously enough, the opinions of these learned gentlemen vary, and even to such an extreme that, whereas some of them assert that dry hydrate of lime (slacked lime) is capable of taking up 40, or even 50 per cent of chlorine gas, some of them declare that hydrate of lime, dried at 100°, does not take up any chlorine gas at all. The authors of this essay, fully convinced that men of eminently high standing in scientific matters, and especially Prof. T. Graham, were not likely to err in their observations, were led by an observation, made by the last-named *savant*, that lime dried over sulphuric acid in the vacuum made by an air-pump behaved differently towards chlorine gas from that dried at 100°. To investigate this subject fully, the authors of this essay commenced by procuring good pure caustic lime, a matter of far more difficulty than one would imagine at first. They succeeded in obtaining this material by taking the caustic quick-lime of commerce, made from pure mountain limestone, soaking that material with oil, and burning or igniting it a second time, after having placed it in a crucible heated in a furnace with coke and charcoal, and a strong blast produced by a pair of blacksmith's bellows. Quick-lime, thus prepared, when placed in water, is instantaneously converted into hydrate of lime, while there is produced, at the moment of contact of the quick-lime and water, a hissing noise, as if of a piece of red-hot iron quenched with water. The authors also prepared a quick-lime from pure white marble, soluble in very dilute hydrochloric acid, without residue; they took care that, whenever they dried the hydrate of lime intended for their experiments, to exclude the access of carbonic acid gas from that hydrate. They next repeated Prof. T. Graham's experiment, working comparatively drying weighed quantities of slacked lime over sulphuric acid, as well as by means of heat, passed chlorine over these quantities for 1½ hours, and expelled excess of that gas, left uncombined by means of a current of dry air free from carbonic acid. The results of their extensive labours are:—1st. Slacked lime, retaining even as small a quantity as 0·4 per cent of water (as is the case with that dried over sulphuric acid *in vacuo*), and any larger quantity of water retained is sufficient to effect the formation of hypochlorite of lime at any temperature. 2nd. Hydrate of lime, dried at 100°, or even at 130°, is converted into hypochlorite of lime, even at 0° (32° F.), provided the lime is freely allowed to become heated by the absorption of chlorine gas; but, if by means of keeping the temperature at 0°, or even lower, the lime is prevented becoming heated, no action at all, or only a very slight one, took place. The authors call attention to the often-overlooked fact that it is very difficult to obtain a chlorine gas quite free from hydrochloric acid gas, against which they have taken peculiar precautions in the course of the experiments just alluded to.

Behaviour of Chlorine, Iodine, and Bromine towards a Solution of Permanganate of Potassa.—M. W. Lindner.—The author says, when, to any solution containing a compound of iodine, a drop of a dilute solution of permanganate of potassa is added, the peculiarly characteristic colour of the latter substance is changed into brown—that is to say, that iodine is set free and the permanganate reduced. It does not matter whether the original solution of the iodide has an acid or an alkaline reaction, for, in the former case, the fluid will be clear and transparent, in the latter turbid. A neutral solution of a bromide is not affected by the permanganate, neither is an alkaline solution; but if the solution of the bromide is acidified with nitric acid, the reaction, on addition of the permanganate, takes place in the same manner as for the iodide solution. A solution of a chloride is never, under any conditions, acted upon by the permanganate. The author states that, even when solutions of iodides or bromides are so dilute as hardly to be detected by nitrate of silver, the permanganate never fails to detect the presence of them, but does not, at the same time, distinguish between iodine and bromine, for which purpose the specially-distinguishing reagents for these two halogens have to be applied.

Les Mondes, July 8, 1869.

We find in this paper the following original communications:—

Agronomical Map of France.—M. Delesse has received, from every canton the empire is subdivided into, two average samples of the arable soil of each of these small districts, taken at a depth of 15 centimetres below the surface. The author has thus in hand 6000 samples, and proposes, after chemically and mineralogically testing and classifying them, to employ the information thus obtained in constructing an agronomical map of France, whereupon the nature of the soils of the divers localities will be clearly indicated.

Electrical Phosphoroscope.—M. Laborde.—This instrument is based upon the same principle as that of M. Becquerel; its essential parts are a Ruhmkorff induction apparatus, the spark of which throws light on the phosphorescent object, and of a sliding frame, one of the ends of which hides the object during the brief moment it is illuminated by the electric spark. This sliding frame is 40 centimetres in length by 10 centimetres in breadth; it is fixed at its centre on an axis, which may be made to move rapidly by means of a pedal. The arrangement of this apparatus, which is rather confusedly described in the original, and could not be well understood without a diagram, is such as to render it serviceable for studying the phosphorescence excited by a blow, as well as by friction. The phenomena of phosphorescence of substances which, like nitrate of uranium, is only of very short duration, can be observed by means of this instrument equally well as the long-continued and strong phosphorescence induced by friction in pieces of porcelain or glass.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 197, May, 1869.

The greater part of this periodical is devoted to mechanical science. The only paper of interest to chemists is a lengthy report on the—

Manufacture and Use of Animal Phosphated Chlorinated Manure.—Dr. Boucherie.—All farmers know that now and then it happens that horses, cattle, or sheep die; and it is chiefly the disposal of their carcases which the report here alluded to treats of. The skin is taken off, and, after having been disinfected, is sold; the

intestines are mixed with quick-lime, and buried in a spot to be always kept for such a purpose; the remainder of the carcase is cut into pieces weighing from 5 to 6 kilos., and placed in a wooden tank lined inside with lead, and of about 120 cubic feet capacity. Water is added to the remains of the dead beast, bones included, and about 400 kilos. of crude commercial hydrochloric acid; ebullition is effected by means of the introduction of steam, obtained from the portable steam boiler; after boiling for about six hours, the entire mass is disintegrated. In order to destroy the very unpleasant smell resulting from this ebullition, some lumps of peroxide of manganese are added, whereby a slow but constant disengagement of chlorine gas, is obtained, and all disagreeable smell avoided. When the liquid and contents of the tank are thoroughly cold, the solidified fat which floats on the top is taken away, and fit for the soap or candle maker; the clear liquid is run off and mixed with 200 kilos. of coprolite powder, or bone-ash, and thus converted into a useful manure. At the bottom of the tank will be found a brownish-coloured pulpy mass, which has lost all traces of organised structure, and this material, after having been mixed with some mineral phosphate, is also applied as manure. The following is the composition, in 100 parts, of the liquid manure here alluded to, previous to its being mixed with mineral phosphate:—Water, 79·60; organic matter (containing 1·28 per cent of nitrogen), 10·65; ash (containing 2·38 per cent of phosphoric acid), 9·45. The brownish pulpy mass contains, in 100 parts:—Water, 16·75; organic matter (containing 3·90 per cent of nitrogen), 31·17; ash (containing 8·20 per cent of phosphoric acid), 52·08. The quantity of materials obtained at each operation is stated to amount to about 70 kilos. of fat, 1500 litres of liquid, and 700 kilos. of brownish pulpy animal matter; these quantities, however, will vary according to the size, weight, and nature of the animals so disposed of. This process is recommended above the burial of dead animals; and in some communes of France, it is already ordered to be adopted in all cases, since it is a useful addition to the sanitary regulations of the country.

Programme de la Société Hollandaise des Sciences de Harlem, Année, 1869.

On the 15th of May, the general yearly meeting of this scientific society was held at Harlem. The meeting approved of the proposal made by a committee, to found two additional medals, each of the intrinsic value of 500 florins (about £42), one of which will bear the name and effigy of Huyghens, the other that of Boerhaave. These medals are intended to be given, every alternate two years, to those scientific men, native or foreign, who, by their researches, discoveries, or inventions, shall, according to the opinion of the Society, have most contributed, during the last twenty years, to the advancement of a specific branch of physico-mathematical, or natural history sciences. The Huyghens medal will be awarded, in 1870, to natural philosophy; in 1874, to chemistry; in 1878, to astronomy; in 1882, to meteorology; and in 1886, to mathematics (pure and applied). The Boerhaave medal will be awarded, in 1872, to mineralogy and geology; in 1876, to botany; in 1880, to zoology; in 1884, to physiology; and in 1888, to anthropology. The preliminary award shall be made according to the advice of a committee to be appointed by the directors of the Society, of which committee the secretary of the Society shall be a permanent member. The final award shall be made at the general yearly meeting of the Society, after it shall have discussed the report and heard the full explanation given by the committee just alluded to.

Among the questions open for competition, and to be answered on or before the first of January, 1871, we notice the following:

The Society asks for an accurate description of all chemical or physical operations, whereby either accidentally, or as a consequence of direct experiments, chemical compounds have been obtained, which, by their chemical and physical properties, agree with native minerals. The Society does not desire that new minerals should be artificially formed, but simply an accurate and critical review of the results already obtained; while it is also requested that all the published and printed memoirs wherein such artificially-made minerals have been described shall be fully mentioned.

The Society desires a monograph on albuminous substances; this work to include an historical sketch of all the researches made concerning these substances, and a critical review of the divers opinions which, at the present day, are current in science in reference to these materials.

The Society desires that the co-efficients of expansion, by heat, of divers kinds of glass, and more especially the glass used for making thermometer tubes, be very accurately determined, according to M. Fizeau's method, for temperatures according to the centigrade scale, from —30° downwards to 500° upwards.

Since more recent researches appear to confirm the opinion that the substances known as hydrates of carbon are polyatomic alcohols, the Society desires that new researches be made in order to clear up and fully elucidate this point.

Since the accurate determination of temperatures above 350° is a matter open to great improvement, the Society has decided to grant its gold medal to him who shall succeed in the construction of a simple apparatus whereby temperatures up to 500° are correctly indicated.

The Society asks accurate determinations of the various indices of refraction of water, for at least 12 points of the spectrum, over a range of 50°.

It is well known that the Aurora Borealis causes telluric electric currents, which occasionally disturb the proper action of the electric telegraph wires; the Society desires that, on telegraphic lines of great length, the force of these currents be determined, and that it be also ascertained how far these currents extend towards the equator.

The two questions which the Society desires to receive replies upon, on or before the 1st of January, 1873 (both bearing upon natural history), we need not quote, but specially notice the following questions to which answers are expected on or before the 1st of January next, these questions having been propounded and published last year:—

Since it cannot be denied that spectrum analysis, now almost the order of the day, has been overrated, and its value exaggerated, it is desired that, in order, also, to obtain more sound views on this matter, that which is true and that which is false therein be equitably sifted; that the limits be stated up to which this method is of legitimate use, and beyond which it fails to be applicable; and, lastly, that a critical review be made of all facts brought to light by this branch of experimental research, and, also, that it be pointed out what science has to expect of its extended application.

The electric current heats the metallic conductor which is traversed by it; hence the resistance the current experiences is increased, and in this manner the current reacts on itself. We may, on the other hand, suppose that the intensity of the current modifies the value of this resistance by virtue of an action which does not directly depend upon the heating. It is desired that the influence exercised by the intensity of the electric current on the degree of resistance be investigated in both points of view just mentioned. Among the metals which seem to offer the best chance of success for this kind of investigation, mercury holds a prominent place.

The repetition, extension, and criticism is asked of the experiments concerning the electrolysis of the fused haloid salts (Faraday's "Experimental Researches," T. I., art. 538 and following, and 978 and following); also an *exposé* of the theories of the nature of electrolysis which can be deduced therefrom. Faraday's law of electrolysis is very simple; but the question is not yet exhausted, and the whole phenomenon is obscure. It is therefore desired that it should be rigorously decided up to which point the above mentioned experiments are in opposition with this higher view, and aided by a great many facts, according to which no real electrolysis whatever should take place unless the action of the current be only

exerted upon double salts, or upon combinations equivalent and analogous therewith.

According to M. G. Ville (see his *Revue des Cours Scientifiques*, 1868, No. 7, p. 103), nitrogen, in its free or elementary state, should be assimilated by some kinds of plants, especially those belonging to the *Leguminosæ*; the Society therefore asks that this opinion be submitted to a critical examination, and that the truth or falsity of this opinion be fully made out on theoretical as well as on experimental ground.

In reference to the extremely interesting and highly-valued experiments of Mr. Graham, Master of the Mint, the Society asks for new researches on the absorbing and dissolving power of molten metals for hydrogen gas, especially with the view to determine whether there do exist definite combinations of hydrogen and metals. The Society desires to have experiments made with various metals, in order to ascertain, with certainty, the fact whether the assertion that metals become transparent at a sufficiently high temperature holds good, or is to be rejected.

Since there yet exists a great deal of uncertainty on the subject of the cause of the phosphorescence of substances called artificial phosphori, the Society requests that a thorough research be made to establish the fact that this phosphorescence is only due to a slow oxidation.

Whilst the pressure of the air, the direction and force of the wind, and the temperature of the air are continuously recorded at the meteorological observatories, by means of self-acting and self-registering instruments, the degree of moisture of the air is as yet only recorded by a few isolated observations made at certain hours of the day-time. The Society desires the construction, either upon an entirely new plan, or according to the principles indicated (see *Poggendorff's Annalen*, vol. xciii., p. 343), of a self-acting or self-registering instrument for determining the degree of moisture of the air, and the publishing of results of observations obtained by means of such instrument for at least one half-year continuously.

The Society desires to recommend, to the competitors for prizes, to omit, in their answers to questions, any matters not directly relating to the proposed question; it is, moreover, desired that, whatever be sent into the Society should be worked out with precision, and that every proposition be well defined and demonstrated, and not mixed with vague theories or badly digested and not well established facts. The memoirs sent in must on no account whatever be written in the handwriting of the authors themselves, since, if even these memoirs might be worthy of the award of the medal, and it turned out that such documents were written in the author's own handwriting, no award whatever could be made, according to the Society's rules. The envelopes added to the memoirs sent in, and appended thereto by a peculiar mark, and containing the author's name, will, in case no award is granted, be destroyed by fire, unopened. The memoirs to be sent in for competition may be written in Dutch, French, Latin, English, Italian, or German languages, at the author's option, provided, in the case of the German language, the italic, and not the peculiar German mode of writing, be used. All such documents, and the envelopes appended thereto, and just alluded to, should be sent, carriage or postage paid, to Dr. E. H. von Baumhauer, the Secretary of the Society, residing at Harlem, North Holland, Netherlands.

The prize offered for a satisfactory memoir, or answer, to each of the proposed questions, is the Society's gold medal, value 150 florins (£12 10s.), bearing the author's name and the year of issue, or, if the author might desire it, the full money value of the medal; in some cases, it is left to the umpires of the awards to grant an additional award of 150 florins. The competitor to whose memoir a prize shall have been awarded may not, without the express consent and authorisation of the Society, print or publish, either in whole or part, separately or in any periodical, the memoir to which the prize has been awarded.

Polytechnisches Journal von Dingler, vol. cxcii., No. 5, first part for June, 1869.

We notice the following original papers and communications in this number:—

Researches made in the Laboratory for Technical Chemistry at Brunswick.

a. **Abnormal Behaviour of Saccharate of Lime.**—M. Waldeck.—It is a well-known fact that the combination of lime and sugar yields, with cold water, a clear solution, which, on being heated, becomes turbid, or even gelatinises. A solution having been prepared, by mixing, with a solution of pure sugar in water an excess of slaked lime, shaking this mixture, and afterwards filtering it; on heating this solution, no turbidity ensued at all. This phenomenon gave, of course, rise to further investigation, when it was found that the lime which had been applied in this instance was chemically pure hydrate of lime. On mixing some of the same sugar solution with lime as ordinarily obtained from lime-kilns, it was found to exhibit again the phenomenon of becoming turbid on heating. At first sight, therefore, it would appear as if chemically pure lime behaved differently with sugar solution from what ordinary lime does; but further investigation into this matter brought to light the fact that, owing to the necessity of obtaining a fresh supply of sugar, this substance, and not the lime, was the cause of this discrepancy. The author found that, although at first sight no difference could be detected in the refined sugars applied, yet the last-obtained sample behaved, both with the chemically pure and ordinary lime, in the same manner, yielding a solution which becomes turbid on heating; both kinds of sugar were refined white loaf sugar obtained from the same place and at the same price. Of the first sample, yielding abnormal results, unfortunately no more was obtainable, and therefore the matter remains in some obscurity; but those who are connected with sugar refineries might take this hint, and, perhaps find a valuable means of distinguishing between various samples of refined sugar.

b. **Manufacture of Soda from Sulphate of Soda and Oxide of Iron.**—M. Waldeck.—The author points out that the manufacture of soda from its sulphate, and by the intermedium of carbon (charcoal or small coal) and oxide of iron, would be, in many aspects, a great improvement upon the Leblanc process. He next mentions some experiments to illustrate his views on this subject. He took 105 parts, by weight (three atoms), of sulphate of soda; 40 parts, by weight (1 atom), of peroxide of iron; and 25 parts, by weight (eight atoms) of carbon. This mixture fused readily; treated with water, it yielded a solution which, on passing therein a current of carbonic acid gas, became quite clear, leaving only 2·79 per cent of insoluble residue. However fair the results these experiments gave on the small scale, the author is himself unable to solve a difficulty which, on the large scale, would be an absolute impediment to the action; to wit, that neither cast nor wrought-iron vessels—and, worse yet, no fire-clay crucibles, or furnaces built with fire-bricks—will stand the action which is called into play, leaving out of the question the necessity of absolute exclusion of air during the fusion.

On a Dolomitic Marl, and its Use in the Making of Cement.—L. Gatschenberger.—In the neighbourhood of Heidelberg, a marl occurs which, after being prepared for that purpose, yields a cement of the following composition, in 100 parts:—Lime, 44·22; magnesia, 17·77; peroxide of iron, 3·07; alumina, 5·75; protoxide of manganese, 2·33; soda and potassa, 4·72; silica, 22·14. The author had the opportunity of experimenting with the marl itself; and he states—"I find there are two different modes of obtaining from this marl an excellent hydraulic lime—1st, to burn the marl at a temperature below 400°, whereby the magnesia only loses its carbonic acid, while that from the lime is not expelled; 2nd, to burn the marl at a very elevated temperature, whereby the material is even somewhat fluxed. In the first instance, the magnesia is the active matter, since I have found that it hardens under water with carbonate of

lime perfectly well, but not with caustic lime. In the second instance, the magnesia loses, indeed, its hydraulic properties, but, instead thereof, its activity towards silica is so increased as to behave therewith as lime does in such cases. The author finds that the cement obtained by the application of the very high temperature, is preferable to the ordinarily-obtained hydraulic cements. A very good cement made at high temperature contains, for 100 parts of SiO_2,R_2O_3, 304 parts CaO,MgO, whereby the proportion between lime and magnesia is as 2 to 1.

On Alkanin.—Prof. Bœttger.—The author states that M. Hirzel, at Leipzig, prepares alkanin, the extract of the alkanet root *anchusa tinctoria*, on the large scale. This extract is dissolved in absolute alcohol; and with this solution strips of Swedish filtering paper are saturated, and made use of, after drying, for detecting even the very faintest traces of ammonia. The alcoholic solution exhibits a beautiful red colour, which, even by the ammonia present in tobacco-smoke, or in illuminating gas, is instantly converted into a beautiful blue. The alcoholic solution and the test-paper have, of course, to be kept carefully excluded from all ammoniacal fumes. The red paper may be turned into blue by a very weak aqueous solution of carbonate of soda, and it then becomes an excellent test for even the faintest trace of any acid, turning red therewith at once.

Preparation of Pure Oxygen Gas at the Ordinary Temperature.—Prof. Bœttger.—The author says that, when a mixture is made of equal parts, by weight, of peroxide of lead and peroxide of barium, and there is poured on this mixture dilute nitric acid of a strength of 9° Beaumé, and specific gravity 1·067, a current of pure oxygen, free from ozone and antozone, is given off abundantly. The mixture of the two peroxides alluded to may be kept together in a stoppered bottle in dry state for any length of time.

Analysis of Palm-Nut Meal and Palm-Nut Cake.—Prof. Hohmann.—Palm-nut meal contains, in 100 parts—Water, 8·55; albumen, 19·56; fatty matters, 1·19; starch, 47·73; woody-fibre, 20·04; ash, 2·93. Palm-nut cake contains, in 190 parts—Water, 10·0; albumen, 15·1; fatty matters, 15·9; starch, 41·0; woody-fibre and ash, 18·0. These substances are obtained from the *Elaïs equienensis*, and used as fodder for cattle.

Vol. cxcii., No. 6, second number for June, 1869.

This periodical contains the following papers bearing upon chemistry, and sciences intimately allied thereto:—

Coating of Glass, Porcelain, or Earthenware with a Thin Film of Lustrous Metallic Platinum.—Prof. Bœttger.—Dry chloride of platinum, freed from excess of acid, is mixed, in a small porcelain mortar, with essential oil of rosmarine (*Oleum anthos*) until the original brown-red colour of the salt has entirely disappeared, and has been converted into a black, pitch-like looking mass. In order to effect this result, it will be necessary to renew the essential oil at least three times. When the pitch-like mass has been obtained, the oil is entirely removed, and the pasty mass is weighed, and afterwards mixed with at least five times its weight of lavender oil, and mixed therewith to a homogeneous fluid; this, after having been quietly standing for half-an-hour, is applied with a hair brush on the glass or porcelain objects to which it is desired to give a coating of lustrous platinum; and, after the very thinly and evenly laid on film is dry, the objects are either placed in a red-hot muffle, or heated in the flame of a glassblower's lamp, care being taken not to exceed a red heat.

Black Patina upon Zinc.—M. Neumann.—The author has instituted a series of researches to find out the best and most suitable material to produce upon zinc—or rather upon statuary and ornamental objects made of that metal—a pleasing blackish coating, without the necessity of impairing the effect of the natural colour of the metal, as would be the case when an oil-paint or varnish is used. The best results were obtained by the author when nitrate of protoxide of manganese was used; this salt, on being heated, is decomposed, yielding black peroxide of manganese, and the degree of heat required is not so high as to affect the zinc. To 1 litre of pure water, 54 grammes of the nitrate alluded to, and containing six equivalents of water of crystallisation, is, according to the author, the best solution for this purpose; and the specific gravity of that solution, at 14° R., is stated by the author to be 1·125.

Saponification of Fats when in the state of Emulsion.—M. Waldeck.—This paper confirms the results formerly obtained by M. Mège-Mouries. The author of this memoir points out that forming an emulsion of fats by means of substances such as gum, for instance, would be impracticable for the manufacture of soap, entailing, as it would do, loss of lye as well as of the gum or other similar substance; he, therefore, in consequence of the results obtained by him in experiments expressly instituted, advises the use of alkaline lye for the purpose of forming emulsion; but, if that plan be resorted to for soap-making purposes, the use of distilled water is an absolute requisite, but, of course, no impediment at all, since, where steam is used, distilled water is readily enough obtainable. The emulsed fats are very rapidly and readily saponified.

Portuguese Graphite.—M. Knublauch.—In 100 parts, this material was found to contain—Water (hygroscopic as well as of combination), 10·21; carbon, 38·47; ash, 50·81.

Consumption of Divers Materials used as Substances for the Production of Artificial Light.—Dr. Willigk.—This paper, although very interesting, is too lengthy to admit of useful abstraction.

On a So-Called Disinfecting Soap.—Dr. Pincus.—The author very properly calls attention to an error committed by a chemist and a soap manufacturer, who state that they have succeeded in obtaining a soap which contains permanganate of potassa as an active and disinfecting ingredient. On investigation by the author, he found, as might be expected, that even the freshly made soap only contained oxide of manganese, and a mere trace of permanganate. This latter salt, of course, cannot be kept for any length of time in contact with an organic material, as soap is, without becoming decomposed. The soap was made by incorporating into well-made, hard soap, quite dry, and cut into shreds, powdered permanganate, and then forming this mixture into a cake by strong pressure.

Annales du Génie Civil, No. 6, June, 1869.

This periodical contains a lengthy paper—

On Wine.—M. Boucherie.—Composition of must and of wine: the former contains—Sugar, a nitrogenous principle which is fit for fermentation, ferment, or active yeast, a colouring matter contained in the skin of the grape, but, as yet, not dissolved in the liquid, and oxygen and nitrogen. Wine contains carbonic acid, a small quantity of grape sugar, alcohol, amylic alcohol ($C_{10}H_{12}O_2$), butylic alcohol ($C_8H_{10}O_2$), propylic alcohol ($C_6H_8O_2$), campholic alcohol ($C_{20}H_{18}O_2$), several essential oils (the nature of which is not precisely known), oenanthic ether, aldehyde, valeric acid, acetic acid, butyric acid, glycerine, and the colouring matter of the skin of the grapes dissolved in the alcohol formed by the fermentation. Wine and must, moreover, constantly contain water, organic non-crystallisable matter, gum-like substances (as pectin and dextrin), mannite, and nitrogenous substances; and also the following crystallisable organic acids:—Tartaric, racemic, tannic, malic, pectic, and citric. No *free* mineral acids. The following salts of organic acids and inorganic bases:—Bitartrate of potassa, tartrate of lime, tartrate of alumina, malate of potassa, malate of lime, pectate of potassa, pectate of lime, divers acetates, further nitrates, phosphates, sulphates, silicates of the above-named bases, and also chlorides, iodides, bromides, and fluorides of these bases; while wine contains infinitesimal doses of soda, oxide of iron, alumina, oxide of manganese, magnesia, and ammonia. The quantity of alcohol naturally present in 100 parts of wine varies very considerably, and varies according

to the locality where it is grown, the climate during the time when it was grown, and the variety of grape from which it is obtained. For red Bordeaux wines of average good quality, the quantity of alcohol varies from 8·10 to 10·85 per cent (the author does not state whether he means by bulk or by weight). For white Bordeaux wines, it varies from 9·25 to 15 per cent on average good wine and divers brands. For Burgundy wines (red variety), the quantity of alcohol varies from 10·10 to 13·09 per cent; white variety, from 12·22 to 14·90. Good Roussillon contains about from 16·20 to 17·25 per cent of natural alcohol. White hermitage wine contains, on an average, 16·0 per cent of alcohol. Effervescing champagne contains 11·20 per cent of alcohol, while genuine port wine contains naturally from 22·50 to 23 per cent of alcohol, and marsala as much as 25·09 per cent. This alcohol, be it understood, is absolute and anhydrous.

The other papers of this periodical are devoted, as might be surmised from the title, to matters quite foreign to the subject just briefly abstracted, and of no direct interest to our readers.

Zeitschrift für Chemie, von Beilstein, No. 11, June 26, 1869.

This periodical contains the following original papers:—

Synthesis of Crotonic Acid.—M. Stacewicz.—The author says—My starting point is taken from the well-known constitution of the acrylic acid series, and this made me expect to succeed in synthetically preparing crotonic acid, according to the scheme expressed in the following formulæ—

$$C_2H_2\left\{\begin{matrix}ClO\\H\end{matrix}\right\}O + C_2H_4Cl + 2Ag = C_2H_2(C_2H_3)\left\{\begin{matrix}O\\H\end{matrix}\right\}O + AgCl.$$

The experiment was crowned with success, but the acid obtained differs from that prepared from cyanide of allyl. The mixture of chloracetic acid, chloraceten, and silver is heated, in a sealed tube, up to 140°, and, after the end of the reaction, the contents of the tube are submitted to fractional distillation. At 127°, an oily fluid is obtained, soluble in water, exhibiting a feebly aromatic smell; this fluid reddens blue litmus paper, and acts, when in contact with the skin of the human body, as a blistering agent. The silver-salt of this acid, $C_4H_5AgO_2$, is difficultly soluble in water, and crystallises in dendritic groups; the formula for crotonic acid is, therefore—

$$C\left\{\begin{matrix}H\\CH_2.CH_2\\\text{————}\\O\\OH\end{matrix}\right.$$

On Chlorinated Toluidine, and a New Mode of Preparation of Bromobenzoic Acid.—M. Wroblevsky.—Chlorinated toluidine is prepared by passing through acetotoluid, $(C_2H_3O)HN.C_7H_7$, chlorine gas, whereby chloracetotoluid is obtained, which is purified by repeated recrystallisation from its solution in water. This substance, which is composed according to the formula—

$$C_6H_3Cl(CH_3).NH(C_2H_3O),$$

crystallises in large foliated crystals, fuses at 99°, is readily soluble in alcohol, less so in water; on being boiled with an alcoholic caustic potassa solution, acetic acid is formed, and chlorotoluidine—

$$C_6H_3Cl(CH_3)NH_2.$$

It is a colourless fluid, boils at 222°, is soluble in alcohol, but almost insoluble in water. From ortho-bromotoluol, a colourless liquid, which boils at 182°, the author prepared, by treating it with bichromate of potassa and sulphuric acid, ortho-bromobenzoic acid; this is a solid substance, which fuses at 153°, and then sublimes in long needle-shaped crystals, identical with those of the same compounds as obtained from benzoic acid.

On Sulphate of Lime and Potassa.—M. H. Struve.—This double salt was first discovered by M. Phillips, in the year 1850. The author of this paper says—When crystals of sulphate of lime are put into a saturated solution of sulphate of potassa at 12° (the specific gravity of that solution being 1·0716, and containing 9·41 per cent of the anhydrous sulphate of potassa), the crystals of sulphate of lime are soon converted into somewhat bulky pseudomorphic crystals of the double salt of sulphate of lime and potassa. When the solution of sulphate of potassa is more dilute, the change takes place more slowly; and when, in 100 c.c. of water, only 2·365 grms. of sulphate of potassa are dissolved, the sulphate of lime is simply dissolved therein without forming a double salt; burnt gypsum and native anhydrite behave in the same manner. The formation of similar double-salts takes place, but more slowly, when sulphate of lime is put into concentrated solutions of the chloride, bromide, and iodide of potassium; the same takes place with solution of nitrate of potassa.

New Mode of Formation of Anhydrite.—M. Struve.—100 parts of sulphuric acid (sp. gr. 1·82) dissolve, at ordinary temperature, 1·992 parts of artificial anhydrite (anhydrous sulphate of lime) and 1·953 parts of native anhydrite. When, to a quantity of 4 grms. of crystallised gypsum, were added 135 grms. of the same sulphuric acid, a solution was obtained which contains, for 100 parts of acid, 1·059 parts of $CaOSO_3$. When the solution of $CaO\text{-}SO_3$ in SO_3HO is diluted with its own weight of water, a complete precipitation of gypsum took place after a time; no lime could be detected in the filtrate.

Preliminary Notices.—M. Wislicenus.—This paper treats briefly—

On Sulphaceton, and on the Conversion of β Oxybutyric Acid into Crotonic Acid.—As, however the author states that his researches are as yet incomplete, and will be treated more fully hereafter, we abstain at present from further notice of them.

Researches on Piperinic Acid.—MM. Fittig and Mielck.—This is a lengthy memoir, chiefly treating on the products of oxidation of piperinic acid, which, when acted upon by permanganate of potassa in aqueous solution, yields a cystalline substance (formula, $C_8H_6O_3$), which body the authors called *piperonal*. It is difficultly soluble in cold water, more readily in boiling water, and very soluble in alcohol; it is in every way soluble in the latter fluid and in ether at the boiling temperature of these fluids. Piperonal fuses at 37°, and boils, without decomposition, at 263°. Piperonylic acid, $C_8H_6O_4$, is obtained in small quantity, simultaneously with the last-named substance, during the action of permanganate of potassa; moreover, piperonylic acid is readily obtained from piperonal by the action of permanganate. The acid just alluded to is a solid substance, crystalline, soluble in water and alcohol, fusing at 227·5°, subliming already below its point of fusion; it is a monobasic acid. Nitric acid acts most energetically upon piperinic acid, even when the former is dilute; the result of this reaction is the formation of an amorphous reddish-coloured substance, which baffled the efforts of the authors in obtaining reliable analytical results. After having, at great length, described the bromine reaction upon piperinic acid, the authors state that their researches are not as yet sufficiently complete to enable them to speak with confidence about some of their results.

Synthesis of Acids Homologous with Cinnamic Acid.—MM. Fittig and Bieber.—According to M. Bertagni's statement, cinnamic acid is formed when oil of bitter almonds is heated with chloride of acetyl; relying on this fully borne out statement the authors thought that when, instead of acetylchloride, homologous chlorides were taken, homologues of cinnamic acid would be formed; this idea has been experimentally tested, and the authors met with correct results; when equal equivalents of oil of bitter almonds and butyryl chloride are mixed and heated in sealed tubes, first to 100°, the reaction takes place, but only slowly; at from 130° to 140°, the reaction is more rapid, but yet takes several days for its completion; an acid was obtained of the formula, $C_{11}H_{12}O_2$, which the authors have

named phenylangelic acid, because it stands in the same relation to cinnamic acid as angelic acid stands to acrylic acid; the quantity of acid obtained in this reaction is very small, the greater portion of the oil of bitter almonds being converted into a blackish resin, insoluble in solution of carbonate of soda.]

On Ethyl-Phenol.—MM. Fittig and Kiesow.—Ethyl-phenol is prepared in pure state from ethyl benzol sulphate of potassium, which is submitted to distillation at from 270° to 280°, after having been mixed with thrice its weight of hydrate of potassa; the purification of the raw product thus obtained is a slow and tedious process; at length a solid substance, partaking of a regular crystalline form and fusing at about 48°, is obtained; this body is the ethyl-phenol—

$$C_8H_{10}O=C_6H_4\left\{\begin{matrix}C_2H_5\\HO\end{matrix}\right.$$

it boils at 210°, but volatilises even at ordinary temperature.

On Amido-Benzoic and Nitrophtalic Acids.—M. Faust.—When nitrophtalic acid is reduced by means of tin and hydrochloric acid, amido-benzoic acid is formed, which is in every respect identical with amido-benzoic acid obtained by other means; it is a crystalline solid, containing, in 100 parts, C, 61·3; H, 5·1; O, 34·6. The author says he desires to rectify a statement made in a former number of this periodical, wherein he described as an ether what has afterwards been ascertained to be nitrophtalic acid—$C_8H_3(NO_2)O_4.C_2H_5.H$.

Conversion of Aldehyde into Aceton.—M. Schloemilch.—The author states, as a preliminary notice, *pour prendre date*, "I have succeeded in doing what is indicated under this heading, but am as yet occupied with further researches on this subject." This observation also extends to the contents of the brief notices of the following subjects:—

On Lepides and Oxylepides.—M. Limpricht.

On the Bromo-Substitution Products of Dibenzyl.—Same author.

Synthesis of Anhydrous Lactic Acid.—Dr. Von der Brüggen.—The author says, when anhydrous lactic acid is considered as being an ether, it follows that it must be possible to obtain this acid by the action of bromo-propionic acid on lactate of potassa; this, the author states, he has actually carried out experimentally. His paper, however interesting, is so filled with formulæ, exhibited somewhat in the style of genealogical tables, that it would take up more room than we can afford, and therefore content ourselves with announcing in this brief notice the scientific *fait accompli*.

Preparation of Oxalate of Acetonin.—M. E. Mulder.—Aceton is added to sulpho-carbaminate of ammonium; the crude sulpho-carbaminate of acetonin thus obtained is washed with alcohol of 90 per cent, next dissolved in water, precipitated by means of perchloride of mercury, filtered; H_2S is passed through the filtrate; the latter is evaporated to dryness on a water-bath, the residue treated with absolute alcohol (which leaves $ClNH_4$ undissolved, and keeps hydrochlorate of acetonin in solution); water is next added, then again evaporated to dryness, the residue treated with $C_2O_4Ag_2$ in excess, filtered, the filtrate again evaporated to dryness, and afterwards exhausted with absolute alcohol until nothing more is dissolved; the oxalate of acetonin deposits from the solution and is purified by re-crystallisation; it exhibits a beautifully crystalline mass. Formula—

$$C_2O_2.C_9H_{20}N_2O_2+2H_2O.$$

The following are only preliminary notices on the respective subjects, of which more full research is going on:—

Kreatin and Aldehyde.—MM. Mulder and Moutheran.

Action of Bromine on Butyrate and Valerianate of Silver.—M. Borodin.

Isomers of Valerianic Acid.—Dr. Schneider.—The remainder and smallest portion of this number is, as usual, devoted to abstracts from divers papers, *Comptes Rendus*, &c., which are chiefly of last year's date, and already noticed by us.

No. 12, June 30, 1869.

This number does not contain any original papers at all, but we find in it some communications taken from a paper or periodical published in Switzerland, but, as stated, only printed for private circulation among the members of a society for the diffusion of useful knowledge, established at Zürich. The first of these papers is on the

Solutions of Iodine in Water and Aqueous Solution of Iodide of Potassium.—Messrs. Dossios and Weith.—The authors prepared, in the first place, perfectly pure distilled water, and employed pure iodine, free from chlorine, which they dissolved in the water, and which they ascertained to be, by means of volumetrical estimation with hyposulphite of soda, 0·01519173 grm. of iodine in 1000 c.c. of water. They found this quantity of dissolved iodine increased already after two days, and gradually increasing more and more, so much so that, about three months after having been first made, the solution contained nearly twice as much iodine. The authors ascertained the presence of hydriodic acid, conclusively proving that decomposition of water takes place. The authors also instituted a series of experiments to ascertain whether solutions of iodine in aqueous solutions of iodide of potassium are chemical combinations, or simply mixtures. The result of their experiments is not favourable to the idea that these solutions should be chemical combinations. since it is readily possible to withdraw the iodine from these solutions, not only by simple solvents of iodine, but even by the passing through of a current of air. From some quantitative experiments made with perfectly pure materials, it appears that, at a temperature of 7·9°, and with solutions wherein the quantity of iodide of potassium varies from 1·802 to 12·643 per cent, the quantity of pure iodine thereby dissolved ranges from 1·173 to 12·060 per cent.

Combinations of Ammonia with Cyanide of Silver and Sulphocyanide of Silver.—M. Weith.—The author says that, when cyanides in solution are treated with ammoniacal solution of silver, a crystalline compound of cyanide of silver and ammonia, $CNAgNH_3$, is obtained, which, either on exposure to dry air, or by being placed in water, loses the ammonia; but this compound is, after all, the author states, a true combination, and not a mixture. Sulphocyanide of silver and ammonium, $CNS.Ag.NH_3$, is obtained when sulphide of silver is dissolved in warm and concentrated ammonia. It is a crystalline solid body, which is readily decomposed on exposure to the air, but which may be heated up to 200° when surrounded by ammonia solution.

Behaviour of some Double Cyanides towards Ammoniacal Solution of Silver.—M. Weith.—With the view of separating the cyanogen from ferrocyanide of silver by means of peroxide of mercury, according to a plan published by Prof. Rose, the author of this paper found that this decomposition only takes place very incompletely and slowly. The same was observed when it was tried to decompose the aforesaid ferrocyanide by means of hydrate of potassa. The decomposition is, however, very readily and completely effected by boiling the ferrocyanide of silver with liquid ammonia; in that instance, the iron is separated as oxide; while the solution contains cyanide of silver and cyanide of ammonium—

$$Cy_6FeAg_4+2NH_3+H_2O=FeO+4AgCy+2NH_4Cy.$$

The author calls attention to the fact that it is stated that ferrocyanide of silver is insoluble in liquid ammonia. This is right to a certain extent; but even in the cold, and more so on being gently heated, this fluid will exhibit, after filtration, and on addition of a few drops of dilute sulphuric acid, a more or less copious precipitate of cyanide of silver. When ferrocyanide of silver is mixed with an ammoniacal solution of nitrate of silver, instead of with ammonia only, and heat is applied, the iron is separated as oxide; while from this

solution the whole quantity of cyanogen may be separated, on addition of a few drops of dilute nitric acid, as cyanide of silver. Ammoniacal solution of nitrate of silver behaves with ferro- and ferricyanides of potassium, with ferrocyanide of iron (Berlin blue), and other similar compounds (cobalticyanide of potassium inclusive), in a similar manner. Ferrocyanide of copper, however, cannot be treated in this manner, since the presence of copper gives rise to separation of silver in the metallic state.

The subject matter of all the other papers contained in this number has been treated in our columns already.

Journal de Pharmacie et de Chimie, June, 1869.

This periodical contains the following original papers:—

Researches on Protoxide of Nitrogen in Solution.—M. S. Limonsin.—The author says that the great solubility of this gas in water, especially if its temperature is rather low, induced him to try what the physiological effects of such a solution would be upon men (the author himself) and upon animals. With the main portion of his paper (being, strickly speaking, a chemico-physiologico experimental essay) we will not occupy ourselves. The solution of the protoxide of nitrogen in cold water, and obtained under ordinary pressure of the atmosphere, tastes sweetish, and decidedly saccharine, if, by means of pressure, water has been made to absorb a large bulk of this gas; as might be expected, this solution is readily decomposed by substances capable of taking up oxygen. The main point of importance in this paper is the anæsthetic action of the gas and solution alluded to.

Action of Chloroform upon Frommherz's Fluid.—M. Beaudrimont.—Frommherz's fluid is the *cupro-potassic tartrate*. The author's paper contains the results of some experiments made with the view to prove that, when even a very small quantity of chloroform—for instance, two drops—are mixed with 100 c.c. of water, and there is added thereto a small quantity of the double tartrate of potassa and copper, reduction of the latter takes place almost instantaneously when gentle heat is applied. The author has based upon this property a volumetrical method for the estimation of chloroform; and, notwithstanding the great volatility of that fluid somewhat interferes, the author has succeeded in his object. One equivalent of chloroform (119·5) reduces four equivalents of copper; 10 c.c. of Frommherz's liquid, containing 0·15 grm. of metallic copper, required 12 c.c. of a solution of chloroform, containing 1·195 grms. of chloroform, for 100 c.c.; while of a solution of chloroform of twice the strength just stated—to wit, containing 2·39 grms. for 100 c.c.—just 6 c.c. were required.

Arsenical Aniline Reds—Aniline Red of M. Coupler prepared without Arsenic.—M. Roussin.—This being rather a practical receipt than a scientific memoir is not well suitable for abstraction.

The remainder of this periodical is filled partly with abstracts from the *Comptes Rendus*, already noticed by us, and partly with papers relating to toxicology and *materia medica*.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 2, July 12, 1869.

This number opens with a brief notice of the death of Prof. Bérard, at Montpellier, already recorded in our paper; but we meet here with the following particulars, which are of general interest:—The father of the deceased was associated with the celebrated Chaptal, in the business of an extensive chemical factory, yet in existence near Montpellier, where the manufacture of sulphuric acid was first started on the continuous principle, and whereby has been effected the cheap production of that acid, and, by its means, of almost all chemicals. The deceased Dean of the medical faculty established in the city just alluded to, had been, since 1819, one of the corresponding members of the scientific body which now is the Académie des Sciences, but which in 1819 was l'Académie, an institution of very ancient date. A very great portion of this number is again devoted to the rather barren controversy about some letters and papers, purporting to be written by men who died some 150 years ago at the least. Among the papers and communications, we notice:—

Researches on the Products of the Alcoholic Fermentation of Beet-Root Juice.—MM. Pierre and Puchot.—The authors state that they have obtained from that juice, after alcoholic fermentation—(1) vinic aldehyde, ready formed; (2) vinic alcohol; (3) propylic alcohol; (4) butylic alcohol; (5) amylic alcohol. The authors devote this paper more especially to the study of the propylic alcohol, which they say boils, in its normal state, at 98°, while its sp. gr. at 0° is 0·820; its volume at 0° being taken as equal to 1000, it becomes 1115 at 98°, at which temperature its sp. gr. is 0·735. The authors further state that, theoretically speaking, propylic alcohol can be directly formed from sugar, by simply fixation of water and elimination of carbonic acid.

New Researches on the Properties of Explosive Compounds.—Mr. Abel.—The contents of this abstract, which is published in this number at the express desire of the members of the Institute, are already well known to our readers.

Compressibility of Gases at High Temperatures.—M. Blaserna.—The author first refers in this paper to a series of researches made by him on this subject in former years, and published by him in the *Annales de Chimie et de Physique*. He next calls attention to a series of researches on this very same subject recently made by M. Amagat, which confirm both the author's researches and those made long ago by M. Victor Regnault. The author next passes to researches on the motion of gases, which, however, is a mathematico-physical paper, and not suitable for condensation in our columns.

Researches on Sulphur.—M. Chevrier.—The author has studied the action of vapour of sulphur on oxygen, hydrogen, nitrogen, protoxide and deutoxide of nitrogen, carbonic oxide, and carbonic acid. Vapour of sulphur and oxygen gas form a slightly explosive mixture under some conditions, but usually the vapour of sulphur burns off quietly, forming sulphurous acid. Hydrogen and vapour of sulphur yield sulphuretted hydrogen gas very readily and abundantly. With vapour of sulphur and nitrogen the author found no action at all. Vapour of sulphur and the two oxides of nitrogen just alluded to form, in the first place, sulphurous acid; nitrogen is set free, and if a frigorific mixture be applied to the apparatus containing the mixed gases and vapours, large so-called lead-chamber crystals are obtained. Oxide of carbon yields, with vapour of sulphur, oxysulphide of carbon. Carbonic acid and vapour of sulphur, exposed to the discharges of electric sparks, yield oxysulphide of carbon and sulphurous acid. The author of this paper adds a short notice on an—

Improvement of the Preparation of Carbonic Oxide.—When the gas just alluded to is evolved from a mixture of oxalic and sulphuric acids, as is well known, a mixture of carbonic acid and carbonic oxide gases is obtained. This mixture of gases the author causes to pass through a tube made red-hot in a suitable furnace and filled with charcoal previously well re-burnt; and, after having washed the gas through a solution of potassa, and also lime-water, he thus obtains a bulk of the pure carbonic oxide gas three times larger than would be the case if the carbonic acid simultaneously formed were not decomposed by the red-hot charcoal, which must be free from yielding any carburetted hydrogen gases.

No. 3, July 19, 1869.

This number contains the following papers, the contents of which belong to chemistry and sciences allied therewith:—

Explosive Properties of Chloride of Nitrogen and its Propulsive Force.—MM. St. Claire-Deville and P. Hautefeuille.—Chloride of nitrogen was discovered in the year 1812, by M. Dulong; it is the most unstable com-

pound we are acquainted with, exploding most violently by very slight causes. The authors have, however, succeeded —and recorded in this memoir the means applied for this purpose—to estimate and measure with accuracy the force exerted by this substance when it changes its liquid for a gaseous state of aggregation. This they have effected by estimating exactly the quantity of caloric units which are set free at the moment of the explosion of the chloride of nitrogen; this quantity amounts to 38.700. The temperature of the gases, when the explosion takes place in closed vessels, amounts to 2128°, and the pressure of the gases is then equal to 3500 atmospheres, or equal to a pressure of 52,500 English lbs. to the square inch.

Spectrum Observations of Small Stars.—Rev. Father Secchi, S. J.—In a letter dated from Rome, July 13th, the eminent astronomer states that he has succeeded in studying the spectra of stars which are only of the 8th and 9th magnitude. The light emitted by such stars being very feeble, it is gratifying to learn that observation has proved that, among the spectral lines, those of carbon occur, and that the spectra, as seen, appear to prove a common origin for these small stars which are, comparatively, situated near to each other.

On Jacobsite, a New Mineral.—M. A. Damour.—This mineral owes its name to the fact that it has been found at Jakobsburg, in Nordmark, province of Wermland, Sweden. It exhibits regular octahedral crystalline shape; its colour is dark, with a metallic lustre; when pulverised, its colour is blackish brown; it scratches glass; its sp. gr. is 4·75 at 16°; it is attracted by the magnetic needle; is infusible before blowpipe flame, and loses no weight when strongly ignited in a platinum crucible; fuses readily to a bead with borax and phosphor-salt, yielding a yellowish green coloured glass; is insoluble in nitric acid, but slowly, yet completely dissolved by hydrochloric acid, while, at the same time, chlorine gas is given off. This mineral consists, in 100 parts, of:—Peroxide of iron, 68·25; protoxide of manganese, 20·57; peroxide of manganese, 4·21; magnesia, 6·41; and traces of oxide of zinc.

New Process for Obtaining Iron from its Ores.—M. Ponsard.—The author of this paper has applied Siemen's furnace to the manufacture of iron; he states that he has succeeded in producing 1 ton of cast-iron of excellent quality with a consumption of only 1 ton of fuel. The author summarises his results in the following manner:—(1) A great saving of fuel can be made, and iron obtained from its ores, without the use of blast furnace; (2) that, since the heat produced by flame is sufficient to effect all the chemical reactions and melt the metal, there may be used all kinds of fuel which produce gas—that is to say, all kinds of coal, no matter whatever their quality, wood, lignite, peat, hydrogen gas, and mineral oils; (3) it is possible to obtain, at will, a more or less carburetted metal, according to the quantity of carbonaceous matter which is mixed with the ore and placed in the crucibles to act as chemical agent only. Specimens of iron of very good quality, obtained by the process as carried on by the author, were exhibited to the members of the Academy at this meeting.

Magnetic Oxide of Iron and its Salts.—M. Lefort.—The author first reviews some experiments made by him on this subject so far back as the year 1852; he next states that, as a result from these researches, he had found that it was possible to obtain perfectly soluble and well-crystallised salts, which prove that the so-called magnetic oxide of iron (proto-sesqui-oxide) is capable of forming salts. The author prepares the proto-sesqui-oxide by precipitating, by means of caustic potassa, a solution containing a ferrous-ferric salt. The reason why preference is given to potassa is, that an oxide is obtained which is less readily affected by air, and more stable. This oxide, $FeO + Fe_2O_3 + HO$, yields, after having dissolved in hydrochloric acid, and on being left to crystallise while standing over sulphuric acid, a crystalline mass made up according to the formula—

$$ClFe + Cl_3Fe_2 + 18HO.$$

The author has also obtained a sulphate of the following composition:—

$$SO_3FeO + 3(SO_3),Fe_2O_3 + 2SO_3 + 15HO;$$

this salt, and in fact all the salts the magnetic oxide is capable of forming, are decomposed by heat far below the boiling-point of water.

Electricity.—M. Tourdes.—This is a short paper on a curious case of death by lightning, which took place on the 13th inst., at Kehl Bridge, near Strasbourg. The curious point is, that while quite close to the spot where three soldiers were seated under a rather low chestnut tree, two of whom were killed, while the third was rendered insensible and temporarily partly paralysed, there is a building provided with lightning conductors, and near, also, a very large iron railway bridge; yet the tree was struck, and the men seated under it on a bench killed, notwithstanding large masses of metal and excellent conductors of electricity were, at a far greater elevation, at hand for the electric fluid to run along. The author's opinion is that the metal buttons, and other ornaments made of metal, on the soldiers' dresses were the cause of their death by lightning.

New Acid from Sulphur.—M. Schützenberger.—While at a future date we may give a fuller account of the interesting facts contained in this rather lengthy memoir, we now confine ourselves to stating that the author has succeeded in forming a compound made up of a double atom of sulphurous acid, wherin 1 atom of oxygen is replaced by 1 atom of hydrogen; this free and anhydrous acid should be represented by S_2O_3H. The author has proposed to name this substance hydrosulphurous acid; some of its salts have been prepared by the author and obtained in crystalline state; the free acid is a very unstable compound, exerting strong reducing action.

Crystallisation of Metallic Oxides.—M. Sidot.—In this paper, the author records a series of experiments made by him in order to obtain artificially crystallised metallic oxides, starting from the well-known fact that most native oxides and sulphurets exhibit a crystalline form. The author has been occupied in researches with the view to obtain these forms by artificial means, and has succeeded, in many instances, by simply submitting some oxides—for instance, the peroxide of iron—to long-continued and strong heat. By this means, the said peroxide loses a portion of its oxygen, magnetic oxide is formed and simultaneously obtained in a crystalline shape; the sesquioxide of manganese, the oxides of cadmium and zinc, have also been obtained in distinctly crystalline state, by various manipulations and the application of suitable very high degrees of temperature.

Acetic Fermentation of Methylic Alcohol.—M. Béchamp.—The author states that on the 5th of September, 1868, he introduced into a vessel which could be properly closed, a mixture of methylic alcohol, pulp of sheep's liver, chalk, and water; and on the 15th of June last, he opened the vessel and proceeded to test its contents, which he found to consist chiefly of acetic acid and non-decomposed methylic alcohol. His object was to ascertain whether methylic alcohol yields, under these conditions, any higher oxidised compound than acetic acid, which is ascertained to be the ultimate term of oxidation under the influence of the ferments used.

Journal für Praktische Chemie, No. 8, 1869.

This paper contains the following original papers and essays:—

Isomerism of the Derivatives from Naphthaline.—M. L. Schæffer.—This paper treats on naphthols, C_{10}

$H_7.OH$, distinguishing—*a* naphthol, $C_{10}H_8O$; *β* naphthol; naphtholates; naphtholethyl ether, $C_{10}H_7OC_2H_5$; distinguished again into *a* and *β*. The paper is written with the view of proving that the isomerism of each class of bodies derived from naphthaline is a persistent character thereof; the paper is, however, too lengthy for further condensation.

Protein compounds met with in Zea-Maize, Indian Corn.—M. Ritthausen.—The author first reviews the labours of MM. Gorham, Bizio, Berzelius, and Stepf on this subject; and next states that he applied, for his researches, several varieties of maise grown in the botanic garden of Bonn University, at Poppelsdorf. The author obtained a substance which he names fibrine of Indian corn, and which contains, in 100 parts:—C, 54·66; H, 7·45; N, 15·50; S, 0·69; O, 21·70. This substance is insoluble in water, and soluble in alcohol and very weak alkaline solutions.

Alloy of Zinc and Iron.—M. Bayer.—The material here described was accidentally obtained in a Belgian iron smelting works, among a job lot of old iron. The alloy was of a very bright metallic and crystalline appearance, very brittle, so that it could be readily reduced to powder; sp. gr., 7·485; nearly entirely soluble, without residue, in dilute sulphuric and hydrochloric acids. Composition. in 100 parts:—Zinc, 83·66; iron, 13·00; lead, 2·70; tin, 0·06; insoluble residue, carbonaceous matter, 0·20.

No. 9, 1869.

This number opens with a list of the—

Symbols and Equivalents of the Elements.

And further contains the following original papers:—

On a Double Sulphide of Iron and Potassium.—M. Preis.—In order to obtain this compound, five parts, by weight, of iron, five parts of carbonate of potassa, and one part of iron (in the state of *ferrum redactum hydrogenio*) are intimately mixed, and placed in a crucible, and submitted to a gradually-increasing heat, and kept for at least one hour at a bright red heat. The substance thus obtained is a compound, containing, on an average, in 100 parts:—Sulphur, 39·90; iron, 35·34; potassium, 24·16. Empirical formula, KFe_2S_4; rational formula, $KS.Fe_2S_3$.

Protein Compounds contained in Oats.—Dr. Kreusler.—After reviewing the labours of Messrs. Johnston, Norton, von Bibra, and others, on this subject, the author states that he found that alcohol of ordinary strength (80 per cent) extracted the protein compounds from coarsely-ground oat-meal completely. After purifying the substance so obtained, its composition, on submitting it to elementary analysis, was found to be, in 100 parts:—C, 52·59; H, 7·65; N, 17·71; S, 1·66; O, 20·39.

The remainder of the papers are not original, and have been already abstracted by us from the original sources from which they are taken.

Les Mondes, July 15, 1869.

Although the brief notice of the following subject does not exactly belong to the subject matter usually treated in our pages, we cannot refrain from noticing the—

Steam Boiler Furnace.—Invented by M. de Pindray.—The reverend and learned editor of this periodical devotes two pages to this very interesting subject, from which we abstract the following:—Two steam boilers, of the same size, and in every respect identical to each other, were fitted up—one upon M. de Pindray's plan, the other upon the system hitherto considered the best in France—and both submitted, under precisely identical conditions, to a trial, the fuel used being the Friokaisin coal, from the neighbourhood of Charleroy, Belgium. During the trial, which lasted fully four hours, the production of steam by the Pindray system amounted to 9·440 kilos. of steam for every kilo. of coal burned; by the other system, it amounted to a production of 8·001 kilos. of steam for every kilo. of coal consumed. The indicated horse-power was (the pressure on each boiler being rigorously kept up to 4¾ atmospheres) for the Pindray boiler, 124; for the other, 81. The production of steam for every square metre of heating surface amounted, in the case of the Pindray system, to 40·460 kilos., in the other case to 28·530 kilos. While the boiler fitted up to compete with M. Pindray's system of fitting up was confessedly the best, yet the latter gained 16 per cent of economy of fuel, and 42 per cent more effective force. These few data may suffice here; a saving of fuel, and a better application of heat for the purposes of production of steam are of so manifestly great interest, that we think we need not apologise for thus briefly entering for a moment on the domain of steam-boiler and furnace engineering.

July 22, 1869.

We notice from this number the following subjects:—

Wood Engraving by means of an Acid Composition.—M. Dulaurier.—The author states that, by some observations made by him previously, he was induced to try a mixture composed of sulphuric acid, several chromates, and persulphate of iron, to bite away some portions of wood upon which, after having first covered its surface with an asphalte varnish, which protects from the action of the acid composition those parts from which this varnish is not afterwards removed by an engraver's tool, he had engraved his name. This experiment, the author states, succeeded so well that very shortly wood engraving may become a greatly-improved manipulation, by means of the assistance of the biting action of acids. Unfortunately, the author neither states what kind of wood he used, nor also the precise composition of the acid mixture he has applied.

From the *accuse's de réception* of this periodical, we learn that the fifth part of the third volume of the *Archives Néerlandaises des Sciences Exactes et Naturelles*, by Dr. E. H. von Baumhauer, contains:—

Chemical Researches on the Poisonous Principle of the Root of the Cicuta Virosa.—M. Van Ankum.—This principle is an essential oil belonging to the camphine series, and is composed according to the formula $C_{10}H_{18}$; it exhibits rotatory power to the right. The root does not, according to this author, contain any alkaloid at all, either fixed or volatile.

Improved Stove and Chimney.—M. Ch. Joly.—The author states that, as a rule, the millions of chimneys applied in dwelling-houses are so badly constructed that, at the least, the useful calorific effect of the fuel is only from 5 to 10 per cent. In Paris alone, 500,000 cubic metres of wood are annually burnt, exclusive of coke and coals consumed for domestic purposes. The author has invented a combination of stove and chimney well worthy of imitation, and brought into use everywhere. His invention is based on sound principles; but, unless we reproduce the woodcuts annexed to the original, we could not make this matter well understood.

PATENTS.

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1641. J. Wilson, Royal Exchange Buildings, London, "Improvements in the manufacture of wrought iron."—A communication from I. O. York, New York, U.S.A.—Petition recorded May 28, 1869.

1713. I. Hopkinson, Leeds, "Improvements in the manufacture of artificial fuel."

1717. F. Rave, Manchester, "An improved method of extracting colour from vegetable matter."

1719. W. V. Morgan, Cannon Street, London, "Improvements in the manufacture of crucibles and other refractory articles or vessels."—A communication from J. L. Hall, and J. V. Morgan, Montreal, Canada.

1721. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improve-

ments in the manufacture of iron."—A communication from J. Burt, Detroit, Michigan, U.S.A.—June 3, 1869.

1731. J. Duke, Mannamead, near Plymouth, "Improvements in the manufacture of plaster and cement."—June 4, 1869.

1742. T. W. Arkle, Liverpool, "Improvements in the mode and means for extracting, recovering, or collecting copper from water containing the same in solution, and in apparatus therefor."—June 5, 1869.

1782. A. St. C. Radisson, Lyons, France, "Improvements in the treatment of oleine and other fatty matters for the purpose of transforming them into solid materials suitable for the manufacture of candles."

1785. W. L. Wise, Adelphi, Westminster, "Improvements in the manufacture of artificial fuel and in apparatus for the purpose."—A communication from B. Le Quesne and Dumontier, St. Servan, France. June 9, 1869.

1800. G. W. Oliver, Liverpool, "Improvements in the manufacture of explosive powder and in machinery to be used in such manufacture."—A communication from P. A. Oliver, New York, U.S.A.—June 10, 1869.

1817. K. Brown, Glasgow, N.B., "Improvements in the manufacture of iron."—Petition recorded, June 14, 1869.

1832. W. Smith, Bathgate, Linlithgow, N.B., "Improvements in heating or purifying mineral oils."—June 18, 1869.

1855. T. Routledge, Ford Works, near Sunderland, "Improvements in the preparation of materials for the manufacture of paper."—June 16, 1869.

INVENTIONS PROTECTED POR SIX MONTHS BY THE DEPOSIT OF COMPLETE SPECIFICATIONS.

1850. G. W. Fox, Manchester, "Improvements in the treatment of castor, cod-liver, and other medicinal oils, in order to render the same more palatable."—Petition recorded June 16, 1869

1868. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for preparing sulphates, and obtaining fine silver therefrom."—A communication from F. Gutzkow, San Francisco, California, U.S.A.—June 17, 1869.

1884. H. A. Bonneville, Chaussée d'Antin, Paris, "Compounding and applying certain compounds, to render fabrics water repellent."—A communication from R. O. Lowry, Salem, Washington, N.Y., U.S.A.,—June 19, 1868.

NOTICES TO PROCEED.

319. W. A. Smith, Manchester, "Improvements in the preservation of meat, fish, and other perishable articles of food during their carriage by railway, and in apparatus connected therewith."—Petition recorded February 2, 1869.

374. H. A. Bonneville, Chaussée d'Antin, Paris, "A new and improved compound for preparing jelly broth."—A communication from C. J. Desnoix, Paris.—February 6, 1869.

420. J. Clayton, Radcliffe, Lancashire, "An improved paste for fixing and brightening aniline and pigment colours in printing on cotton, woollen, silk, or mixed fabrics."—February 10, 1869.

442. W. E. Newton, Chancery Lane, "Improvements in the manufacture of explosive compounds."—A communication from A. Nobel, Paris.—February 12, 1869.

637. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or purifying oils and fats."—March 2, 1869.

942. E. Morewood, Rock Cottage, Briton Ferry, Glamorganshire, "Improvements in coating metals."—March 29, 1869

1317. A. Meredith, Newgate Street, London, "Improvements in the manufacture of iron and steel."—April 28, 1869.

1469. J. Townsend and P. Forbes, Glasgow, N.B., "Improvements in refining or treating oils and fats, and in apparatus therefor."—May 13, 1869.

1539. W. R. Lake, Southampton Buildings, Chancery Lane, "An improved process for obtaining gelatine and other products from animal substances."—A communication from D. K. Tuttle, O. Lingo, W. J. Hooper, and T. Hooper, Baltimore, Ma., U.S.A.—May 19, 1869.

1575. C. W. Siemens, Great George Street, Westminster, "Improvements in calcining and smelting ores, and in furnaces and apparatus employed in connection therewith, which furnaces are also applicable to other purposes."—May 21 1869.

1642. J. Brömer and H. Gurzkow, Frankfort-on-the-Maine, "An improved method of obtaining the anthracen out of asphaltos, that is to say, pitch produced from coal tar, and of preparing two colouring matters from the anthracen."—May 28, 1869.

426. G. F. Ansell, Bernard Street, Russell Square, Middlesex, "Improvements in the manufacture of steel and iron."—Petition recorded February 11, 1869.

434. H. Edwards, Staple Inn, Holborn, Middlesex, "An improved preserved food."—February 12, 1869.

469. L. N. Legras, Wardour Street, Middlesex, "Improvements in the preservation and disinfection of animal and other substances, and in the apparatus employed therein."

477. F. Walton, Staines, Middlesex, "Improvements in the manufacture of artificial leather."—February 16. 1869.

540. W. Ibotson, New Inn, Strand, London, W. W. Ladelle, Wraysbury, Bucks, and A. G. Southby, Bulford House, near Amesbury, Wilts, "An improved method of, and apparatus for, preparing esparto, straw, rags, or other materials for the manufacture of paper."—February 22, 1869.

781. J. Thomlinson, Carlisle, Cumberland, and W. Thomlinson, Loughborough, Leicestershire, "Improvements in the manufacture of paper and textile fabrics, and in the preparation of gypsum, to be used in such and other manufactures."—March 13. 1869.

836. J. Thomas, Middlesborough-on-Tees, W. Bacon, Newcastle-upon-Tyne, and H. Groves, Redcar, Yorkshire, "Improvements in the manufacture of iron and steel, and in furnaces and apparatus employed therein."—March 19. 1869.

1202. L. Goetz, Leith, N.B., "An improved preparation of materials for cleansing wool, cotton, linen, and other like fibrous substances."—A communication from G. Müller, Neustadt-on-the-Haardt, Bavaria—April 20, 1869.

1721. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of iron."—A communication from J. Burt, Detroit, Michigan, U.S.A.—June 3, 1869.

1800. G. W. Oliver, Liverpool, "Improvements in the manufacture of explosive powder, and in machinery to be used in such manufacture."—A communication from P. A. Oliver, New York, U S.A.—June 10, 1869.

NOTES AND QUERIES.

Isinglass.—Can any of your correspondents inform me of any method of obtaining isinglass, by mixture or otherwise, in the form of a powder.—ICTHYOC.

Crystallisation of Supersaturated Solutions.—Will any of your courteous readers kindly furnish an enquirer, who is greatly interested in the subject, with a list of the bodies which are found to act as nuclei in determining the crystallisation of supersaturated solutions?—R. C. C.

Water Analysis.—I have just finished examining a spring well in the country, and found on evaporating one imperial gallon of the water to perfect dryness, the residue weighed 102 grains, and afterwards ignited and lost by ignition 40 grains. Besides, I found there exists 10 grains N_2O_5 in one gallon. Now I should like to know if it is the rule to deduct the whole, or only a part of this nitric acid, from the loss by ignition when drawing up a report, or how should I act?—J. WALLACE.

Powdering Isinglass.—Isinglass, owing to its toughness, is a substance which it is almost impossible to reduce to powder by means of pestle and mortar; but, akin to horn, to cork, and such like substances, it may be obtained in pulverulent shape by means of a sharp, well-hardened, but not too coarse file. Lump isinglass answers best for this purpose.

Pattinson's Method for Extracting Magnesia from Limestone Rocks.—Would any correspondent obligingly give me the process of extracting magnesia from the limestone rocks containing that earth, by Pattinson's method; it appears to be accomplished by carbonic acid.—W. R.

Testing Acetic Acid.—Can any of your correspondents oblige me by giving through your columns the readiest means of testing the purity and strength of acetic acid.—A. A.

Pattinson's Method for Extracting Magnesia from Magnesian Limestone.—The magnesian limestone is calcined at a dull red heat for some time. By this process the carbonic acid is expelled from the carbonate of magnesia only, but not from the carbonate of lime, which thus remains insoluble. The calcined mass is next reduced to a milk, with water, in a suitable cistern, and the carbonic acid resulting from its own calcination forced into it under powerful pressure. The result is a saturated solution of magnesia, the lime remaining unacted on so long as the magnesia is in excess. The solution, by evaporation, yields heavy carbonate, whilst carbonic acid gas is expelled and may be again used in the same manufacture. Our correspondent should bear in mind that only magnesian limestone can be thus operated upon.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS *give notice that in accordance with a suggestion of* MR. CROOKES, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* MR. CROOKES *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Biography of Dumas.—Dr. Muspratt informs us that his Biography of J. B. Dumas, M.D., was published in the *Lancet* in 1851, vol. 1, p. 248.

F. Caut.—This correspondent wishes to know what public institutions there are for the study of chemistry in Nottingham. Perhaps some of our correspondents can give the desired information.

Communications have been received from Dr. Wood; Mawson and Swan; W. H. Preece (with enclosure); C. Martin; Dr. F. C. Calvert, F.R.S., F.E.S.J.; J. S. Parker; W. Hawkesworth; W. Sim (with enclosure); Smith and Son (with enclosure); Dr. E. Schunck, F.R.S.; Ritchie and Sons; Dr. S. Muspratt; C. Bailey; W. N Hartley; G. G. Walmsley; J. Fordied; H. Mayne; G. Clarke; J. Winter Jones; S. E. Phillips (with enclosure); G. F. Rodwell; J. Wilkinson and Co.; L. F. Haseler, Queensland, Brisbane.

Books Received.—"Sound;" a course of Eight Lectures delivered at the Royal Institution of Great Britain, by John Tyndall, LL.D., F.R.S. Second edition. London: Longmans, Green, and Co. "What is Matter?" by An Inner Temolar. London: Wyman and Sons. "The Retrospect of Medicine," edited by W. Braithwaite, M.D. Vol. lix. London: Simpkin, Marshall, and Co. "The Quarterly Journal of Science." "Popular Science Review."

AMERICAN SUPPLEMENT.

New York, September, 1869.

The Economical Purification of Zinc Containing Iron.

By W. H. Chandler.

In the galvanizing of iron, the article to to be galvanized, after being thoroughly cleansed, is dipped into a kettle of molten zinc, which forms an alloy with the iron at the surface of contact, and by repeating the dipping the thickness of the superimposed zinc may be increased at pleasure. In the prosecution of this manufacture, the zinc is held in large iron troughs or kettles, which are rapidly corroded in those portions nearest the fire. An alloy of zinc and iron is formed, to which also the articles, being galvanized, in some degree contribute. This alloy being heavier than the purer zinc, sinks to the bottom and, from time to time, is removed by perforated ladles.

The composition of the alloy is of course somewhat variable, depending upon the temperature and fluidity of the zinc and the careful straining from the fluid metal. The two analyses here given were made by the writer a number of years since:

Zinc	94·27	94·15
Iron	5·46	5.
Lead	·27	·56
Tin	trace	·29
	100·00	100·00

These samples were taken from a remelting of a large quantity of the alloy, which is the only practicable method of obtaining a fair, average specimen.

The quantity of this dross or refuse is quite considerable, amounting probably, in the United States, to several hundred tons per annum. Formerly it was sold for use in coarse brass castings, and to some extent it was redistilled. At one establishment in Boston circular clay retorts, similar to those in use in the gas manufacture, were employed, the molten alloy being introduced through an inverted syphon in the iron mouthpiece and the condensing tube, connected with the reverse end of the retort, dipping in a pot of molten zinc; thus all access of air to the interior of the retort was prevented and little or no oxidation of the zinc occurred.

Several years since, a small lot of this refuse zinc was received at a metallurgical establishment in Massachusetts, in which the writer was employed as chemist, and in experimenting upon it, one of the foremen of establishment originated a method, by which the zinc could be obtained quite free from iron. Finally, after rebuilding his furnaces and in various ways altering and modifying his manipulations, the samples of purified zinc being analysed after each alteration of the process, a good commercial article was obtained containing only $\frac{1}{10}$ of one per cent of iron.

The process consists in melting the refuse in an iron kettle, raising the heat nearly to the point of volatilization of the zinc, and then by a proper regulation of the heat, cooling the mass slowly from the bottom, by means of a special arrangement of flues. An alloy of zinc and iron, containing a much larger percentage of iron than the original refuse, gradually forms, falls to the bottom of the kettle and is removed by a perforated ladle, while the fluid metal is much purer. The quantity of alloy to be ladled out depends upon the impurity of the original refuse. The purified zinc and the concentrated impurity are melted in separate kettles, and each treated as in the first operation.

One more fusion and refrigeration of the purified zinc and the still more impure zinc, render the former a good commercial spelter and the latter too impure for further economic treatment.

This process is the reverse in its reactions from Pattison's process for desilverizing silver-lead ores. In the latter case the purer lead crystallizes from the more fluid lead and silver, whereas in the former, the more impure alloy separates from the purified zinc.

The residue from this process, which is sold for distillation, consists of hexagonal prismatic crystals of a fixed alloy of iron and zinc, loosely agglomerated together so as to crumble in the hand.

When the operation of refining is badly conducted more or less zinc acts as a solder for the crystals. They are beautifully iridescent, exhibiting all the colors of the rainbow, owing to a surface oxidation. A number of specimens of various colors were selected for analysis and showed a composition of—

Zinc	90·50
Iron	9·50
	100·00

Upon fusing these crystals, which requires a high temperatures, and cooling as before, a small percentage of purified zinc is obtained, and an alloy containing as much as $12\frac{1}{2}$ per cent of iron. This is compact, somewhat brittle and exhibits no evidences of crystallization.

This last mentioned fusion is not made in practice, as the great heat required for its accomplishment rapidly burns out the iron kettles.

By a similar process lead has been removed from zinc with great accuracy, the amount obtained closely approaching the quantity therein. From a lot of Silesian spelter was separated lead perfectly malleable, and containing scarcely a trace of zinc. The purification of the lead, obtained from the process of desilverization of silver-lead by means of zinc, could undoubtedly be accomplished by a modification of this process.

The Humboldt Centennial Celebration.

Upon the fourteenth of September next occurs the one-hundredth anniversary of the birth of this great savant.

In Berlin, the place of his birth and death, a national monument will be erected with appropriate ceremonies. In New York, a colossal bronze bust, representing him in the prime of life, will be unveiled with due solemnities. Professor Francis Lieber will deliver an address in German, and Professor John Draper in English. Numerous German singing societies will take part in the celebration. A banquet will also take place in Irving Hall. In Buffalo, ex-President Fillmore will deliver an address, to be followed by orations in German and English.

American Association for the Advancement of Science.

The eighteenth meeting of the Association occurred at Salem, commencing Wednesday, August 18. The officers of the meeting were:

Col. J. W. Foster, of Chicago, President.

Prof. O. N. Rood, of New York, Vice-President.

Prof. Joseph Lovering, of Cambridge, Permanent Secretary.

Prof. O. C. Marsh, of New Haven, General Secretary.

Dr. A. L. Elwin, of Philadelphia, Treasurer.

Standing Committee.

Col. J. W. Foster.	Dr. B. A. Gould.
Prof. O. N. Rood.	Col. Charles Whittlesey.
Prof. Joseph Lovering.	Prof. A. P. Rockwell.
Prof. O. C. Marsh.	Dr. A. L. Elwyn.

The organization of the Sections was as follows:—

Section A.—Mathematics, Physics, and Chemistry.

Chairman, Prof Joseph Henry, of Washington, D. C.

Secretary, Prof. Henry Wurtz. of New York.

Section B.—Geology and Natural History.

Chairman, Prof. Louis Agassiz, of Cambridge.

Secretary, Prof. T. Sterry Hunt, of Montreal.

The following gentlemen were elected members of the Standing Committee:

Prof. J. S. Newberry and Prof. John Torry, of Columbia College; Prof. Agassiz and Prof. Benjamin Peirce, of Cambridge; Prof. Joseph Henry, of Washington, and Prof. T. Sterry Hunt, of Montreal.

New Mineral Springs.

We give below the analyses of the water of two new artesian wells at Ballston.

The Franklin Spring rises from a depth of 715 feet, the drill passing through the Hudson river shale, the Trenton limestone, the calciferous sand-rock and the Potsdam sandstone, the same strata as penetrated by the old "Ballston Artesian Spring."

The "Condedentonian" well is 600 feet deep, passing through the same strata as the "Franklin" except the Potsdam sandstone, which it does not reach. Both springs blow and spout every forty-eight hours.

	Franklin Spring.	Conde-Dentonian Spring.	
Chloride of sodium	659·344	645·481	grains.
Chloride of potassium	33·930	9·232	"
Bromide of sodium	4·665	2·368	"
Iodide of sodium	0·235	0·225	"
Fluoride of calcium	trace	trace	"
Bicarbonate of Lithia	6·777	10·514	"
Bicarbonate of soda	94·604	34·400	"
Bicarbonate of magnesia	177·868	158·348	"
Bicarbonate of lime	202·332	178·484	"
Bicarbonate of strontia	0·002	0.189	"
Bicarbonate of baryta	1·231	4·739	"
Bicarbonate of iron	1.609	2·296	"
Sulphate of potassa	0·762	none	"
Phosphate of soda	0·011	0·003	"
Biborate of soda	trace	trace	"
Alumina	0·263	0.395	"
Silica	0·735	1·026	"
Organic matter	trace	trace	"
Total per gal. (231 cubic in.)	1184·368	1047·700	"
Carbonic acid gas	460·066	358·345	cub. in.
Density	1.0115	1·010	
Temperature	52°F.	49°F.	

The four analyses which follow are the results of examinations of the waters of Springs in Saratoga. The "Crystal" and "Hathorn's" Springs were recently discovered. The "United States" and "Pavilion" are the old Springs re-tubed. These six analyses were made in the editor's laboratory, the determination of the alkalies and alkaline earths being constantly checked by spectroscopic tests of the precipitates and filtrates.

	Pavilion Spring.	Hathorn's Spring.	
Chloride of sodium	459·903	509·968	grains.
Chloride of potassium	7·660	9·597	"
Bromide of sodium	0·987	1·534	"
Iodide of sodium	0·071	0·198	"
Fluoride of calcium	trace	trace	"
Bicarbonate of lithia	9·486	11·447	"
Bicarbonate of soda	3 764	4·288	"
Bicarbonate of magnesia	76·267	176·463	"
Bicarbonate of lime	120·169	170·646	"
Bicarbonate of strontia	trace	trace	"
Bicarbonate of baryta	0·875	1·737	"
Bicarbonate of iron	2·570	1·128	"
Sulphate of potassa	2·032	none	"
Phosphate of soda	0·007	0·006	"
Biborate of soda	trace	trace	"
Alumina	0·329	0·131	"
Silica	3·155	1·260	"
Organic matter	trace	trace	"
Total per gal. (231 cubic in.)	687·275	888·403	"
Carbonic acid gas	332·458	375·747	cub. in.
Density	1·0075	1.009	
Temperature.			

	Crystal Spring.	United States Spring.	
Chloride of sodium	328·468	141·872	grains
Chloride of potassium	8·327	8·624	"
Bromide of sodium	0·414	0·844	"
Iodide of sodium	0·066	0·047	"
Fluoride of calcium	trace	trace	"
Bicarbonate of lithia	4·326	4·847	"
Bicarbonate of soda	10·064	4·666	"
Bicarbonate of magnesia	75·161	72·883	"
Bicarbonate of lime	101·881	93·119	"
Bicarbonate of strontia	trace	0·018	"
Bicarbonate of baryta	0·726	0·909	"
Bicarbonate of iron	2·038	0·714	"
Sulphate of potassa	2·158	none	"
Phosphate of soda	0·009	0·016	"
Biborate of soda	trace	trace	"
Alumina	0·305	0·094	"
Silica	3·213	3·184	"
Organic matter	trace	trace	"
Total per gal. (231 cub. in.)	537·155	331·837	
Carbonic acid gas	317·452	245·734	cub. in.
Density	1·006	1·0035	
Temperature	50°		

Dangerous Kerosene and the So-called Safety Lamps.

July 22, Mrs. Curley, at No. 17 Hudson avenue, was fatally burned by kerosene; July 23, the building 23 Leonard street was fired; July 30, Carrie Autterfield, 264 West Houston street, died in great agony; August 4, Mrs. George T. Sammis, of Amityville, was, burned to a crisp; August 5, a fire occurred at 263 West Thirtieth street; a few days later Mrs. Caroline Hamblin 408 West Twenty-sixth street, was burned to death. The origin of all these accidents was "*kerosene oil*"—so-called.

The public is most wickedly misled by the venders

of lamps, "*patent safety lamps*," in which they are told they can burn any oil, even benzine, with safety. *Benzine cannot be made safe for use in dwellings, in the hands of women and children, no matter what lamp is employed.* One lamp may be a little safer than another when in perfect order; but lamps will break, oil will be accidentally spilled, the wick tube may be carelessly left unscrewed, in various ways the oil or the vapors may be brought in contact with flame, and, if it is not safe oil, an accident is sure to result. It would be far better for the public if there were no such thing as a "*safety lamp;*" in the full sense of the term there is not. Half the so-called "safety lamps" are no safer than the lamps, which make no claim to safety; while the other half are only safe as long as they are in perfect order and subject to no carelessness in filling or handling. *What is wanted is safe oil, then all lamps will be safe.*

Recent Chemical Patents.

Issued August 3, 1869.

93,157.—Electro-Deposition of Nickel. I. Adams Jr., Boston, Mass.

93,178.—Method of Producing Calcium Light. C. L. Coombe, Washington, D. C., and J. A. Bassett, Salem, Mass.

93,182.—Mode of Preserving Liquid and other Substances. R. D'Heureuse, New York.

93,183.—Preserving Meats, Poultry, Fish, &c. J. E. Dotch, Washington, D. C.

93,267.—Apparatus for Carburetting Air. J. F. Barker, Springfield, Mass., and C. N. Gilbert, New York.

93,270.—Receivers or Carboys for the Manufacture of Muriatic and other Acids. A. Baumgarten, New York.

93,286.—Apparatus for Purifying Whiskey and other Alcoholic Spirits. L. A. DeLime, St. Louis, Mo.

93,288.—Gas Caburetter. B. Dyer, New York.

93,339.—Filter. J. D. Parrot, Morristown, N. J.

93,342.—Electrical Railroad Signal. G. M. Phelps, Brooklyn, N. Y., and R. Stewart, Bordentown, N. J.

93,360.—Vapor-Burner. W. H. Smith, New York.

Issued August 10, 1869.

93,410.—Insulator for Lightning Rods. J. Burnham, Batavia, Ill.

93,411.—Compound Oil for Producing Gas. J. Butler, New York.

93,429.—Flask for Vulcanizing Rubber Plates for Setting Teeth. C. G. French, Springfield, Ill.

93,435.—Portable Gasometer. J. H. Hayward, New York.

93,452.—Apparatus for Utilizing Wells as Refrigerators. J. J. Kiser, Sulphur Springs, Ind.

93,477.—Process of Preparing Iceland and Irish Moss for use in Food. W. J. Rand, Brooklyn, N. Y.

93,478.—Manufacture from Iceland Moss and Carrageen. W. J. Rand, Brooklyn, N. Y.

93,498.—Tanning Composition. N. A. Thornton, Conikee, Ala.

93,523.—Distilling Alcoholic Spirits and Liquors. J. Dennis, Jr., Washington, D. C.

93,563.—Electrical Machine. H. J. Smith, Boston, Mass.

93,606.—Enamelling Wood and other Solid Materials with Hard Rubber. P. Finley, Memphis, Tenn.

93,607.—Deodorizing Compound. R. Fish, Washington D. C.

93,617.—Material for Lubricating Wool and other Animal Fibres. G. F. Henry, J. A. F. Bang, F. R. C. Monestier, and J. P. A. Figuier, Paris, France.

93,625.—Electro-Magnetic Machine. J. Kidder, New York.

93,640.—Modes of Desulphurizing Auriferous and other Sulphuret-Ores. J. H. Rae and T. T. Davis, Syracuse, N. Y.

93,643.—Kiln for Roasting Ores. J. M. Rohrer and J. H. Bassler, Pine Grove, Pa.

93,645.—Process and Apparatus for Extracting Oil from Vegetable and other Matters. T. Sim, Baltimore, Md.

Issued August 17th, 1869.

93,661.—Vapor Burner. J. E. Ambrose, Lombard, Ill.

93,674.—Vapor Burner. L. Chandler, St. Petersburg, Russia.

93,689.—Electro-Magnetic Engine. A. E. Dupas, New Orleans, La.

93,698.—Vapor Burner. T. S. Gates, and A. H. Fritchey, Columbus, O.

93,713.—Manufacture of Iron and Steel. J. Henderson, New York.

93,739.—Process for Purifying Paraffine. C. C. Parsons, New York.

93,752.—Explosive Compound for use in Fire-Arms, Blasting, &c. T. P. Shaffner, Louisville, Ky.

93,753.—Explosive Compound. T. P. Shaffner, Louisville, Ky.

93,754.—Explosive Compound. T. P. Shaffner, Louisville, Ky.

93,755.—Blasting Fuse. T. P. Shaffner, Louisville, Ky.

93,756.—Manufacture of Nitro-Glycerine. T. P. Shaffner, Louisville, Ky.

93,757.—Method of Blasting with Gunpowder, and other Explosive Substances. T. P. Shaffner, Louisville, Ky.

93,758.—Making Cast-Steel. C. W. Siemens, Westminster, England.

93,795.—Apparatus for Carburetting Air. J. F. Barker, Springfield, Mass., and C. N. Gilbert, New York.

93,817.—Manufacture of Sugar of Lead and Acetic Acid. L. D. Gale, Washington, D. C., and I. M. Gattman, New York.

93,840.—Cooling and Ventilating Apparatus. J. J. Schillinger, New York.

93,841.—Process of Preserving Vegetables. F. H. Smith, Baltimore, Md.

93,852.—Apparatus for Ærating and Cooling Distilled Water. G. W. Baird, U. S. N.

93,865.—Mode of Treating Bone-Black, for Filtering Sirups, &c. J. O. Donner, Jersey City, N. J.

93,895.—Single Microscope. J. H. Logan, Allegheny, Pa.

93,899.—Process of Treating Ores with Copper-Amalgam, by means of Electric Currents. A. L. Nolf, and F. L. A. Pioche, San Francisco, Cal.

93,900.—Material for Dyeing and Printing, obtained from Madder. A. Paraf, New York.

93,910.—Process of Treating Leather so as to render it Suitable for the Manufacture of Gloves, &c. N. C. Russell, Gloversville, N. Y.

93,923.—"Salt-Stone," for Salting Cattle and other Animals. V. A. Tugaut, Mulbrouse, France, and P. Schüler, Bienne, Switzerland.

93,941.—Composition for Plastering Walls. D. Young, Kokomo, Ind.

Reissues.

38,003.—Reissue 3,594.—Mode of Purifying Cast-Iron. S. W. Kirk, Coatesville, Pa.

66,773, reissue 3,597.—Division A. Paint. D. R. Averill, New York.

66,773, reissue 3,598.—Division B. Paint. D. R. Averill, New York.

66,773, reissue 3,599.—Division C. Paint. D. R. Averill, New York.

66,773, reissue 3,600.—Division D. Paint. D. R. Averill, New York.

66,774, reissue 3,601.—Division E. Manufacture of Paints. D. R Averill, New York.

79,404, reissue 3,607.—Vapor Burner. J. D. Smith, Greig, N. Y.

85,115, reissue 3,612.—Tub for Distilling Essential Oils. B. P. Van Marter, Lyons, N. Y.

NEW PUBLICATIONS.

The First Annual Report of the Trustees of the Peabody Academy of Science. Salem, Mass.

This report comes to us in the form of a handsomely printed pamphlet of 103 pages. It contains a history of the institution, together with the official documents relating to its establishment, organization and plan of operations. It includes also the report of J. A. McNeil, on his expedition to Central America, and the reports of the curators of the various departments of the Museum. The Ethnological department is surpassed, in this country, only by that of the Smithsonian Institution.

On the Influence of Mental Activity on the Excretion of Phosphoric Acid by the Kidneys. By Luther Hodges Wood, Ph. B., M.D., Silliman Prize Thesis at the Medical Institution of Yale College. 1869. Pamphlet, 26 pp.

From a well-conducted series of experiments upon himself and a careful chemical examination of his urine, the author concludes that the variations, in the amount of phosphoric acid, are not sufficient to afford any indication of the previous mental condition.

He also favors the opinion that the nervous tissue does not disintegrate during healthy mental action, but that it grows, as has been proved true in regard to muscular tissue.

Traite des Matieres Colorantes, comprenant leurs Applications a la Teinture et a l'Impression, et des Notices sur les Fibres Textiles, les Epaississants, et les Mordants. Publié sous les auspices de la Société Industrielle de Mulhouse, et avec le concours de son comité de chimie, par M. P. Schützenberger. 2 vols. in-8 544, 647. Paris 1867.

In this work we have a compendious compilation of information from reliable sources, relating to the tinctorial art, which will supply a need long appreciated, of a manual of the art with its many recent improvements.

After a brief introduction, discussing a few fundamental chemical principles and the physical properties of colors, the author gives a succinct account of the origin of the various textile fibres, the history of their employment in the arts and their preparation for dyeing.

Then follow the general principles of the fixation of colors. The use of albumen is well and quite elaborately written, and the importance of this substance, to dyeing and calico-printing, fully impressed upon the reader.

The classification, of the coloring matters, adopted is as follows:

1. Mineral coloring matters.
2. Artificial organic coloring matters, including the derivatives of uric acid and aniline.
3. Artificial coloring matters, including the derivatives of phenic acid and naphthaline.
4. Vegetable and animal coloring matters.

The work is excellently illustrated by the insertion, under each coloring matter, of specimens of cotton and silk fibrics, colored with the respective agents.

This is a most excellent feature of the work, greatly increasing its value.

The Journal of the Franklin Institute is ably edited by Prof. Henry Morton, Ph.D. Though principally devoted to civil and mechanical engineering, yet it always contains some matter interesting to chemists.

In the July and August numbers are articles upon spectrum analysis by the editor, and in the latter number some interesting spectroscopic notes by Prof. Young of Dartmouth College and an article upon the new chemical nomenclature by Dr. Adolph Ott, of New York.

The Journal is very handsomely printed and illustrated by numerous lithographs and wood-cuts.

BREVITIES.

Prof. John M. Ordway has been appointed Professor of Chemistry and Metallurgy in the Massachusetts Institute of Technology, the chair lately occupied by President Eliot of Harvard University. Prof. Ordway's ability as a chemist, and his great experience in technical chemistry, render this appointment especially fortunate.

Mr. B. M. Peirce has assumed the scientific editorship of *The Mining Journal* of Marquette, Michigan, in addition to his labors as Chemist of several iron mines. Mr. Peirce graduated at Harvard, and studied his profession at the School of Mines in Paris. He is a son of Prof. Pierce of Cambridge.

Prof. J. E. Sinclair, late of the Scientific Department of Dartmouth College, has been appointed to a Professorship in the Technical School at Worcester, Mass.

Prof. Chandler of the School of Mines, Columbia College, sailed for Europe, in the *City of Brooklyn*, for an absence of two months.

Prof. C. U. Shepard of Amherst has gone to Europe.

The seventeenth annual meeting of the Americal Pharmaceutical Association will convene in Chicago, September 7th. The revision of the U. S. Pharmacopœia and the legal regulation of the practice of Pharmacy are prominent subjects for discussion.

Prof. Charles Avery, Professor of Natural Philosophy and Chemistry in Hamilton College, has resigned, and has been elected Emeritus Professor.

The Geological Cabinet of the late D. D. Owen has been bought by the Indiana State University.

The Republic of Uruguay has ordered the adoption of the Metrical system of weights and measures.

Nitro-Glycerine.—A bill has been introduced into the British Parliament, prohibiting the importation of this explosive, and rendering its manufacture and storage within the Kingdom subject to license regulations of the Home Secretary.

A Reminiscence of Barbarism.—The writing of physicians' prescriptions in Latin, and the numbering of the same, instead of a clear, plain statement of their composition and an intelligible label upon the package containing the medicine. In olden times, in the days of superstition and ignorance, the majority of the, so-called, physicians were sorcerers and charlatans, who supplemented their want of knowledge by mysterious signs and incantations; but in these days of enlightenment, when the true physician is a man of science, and his skill, not in reading Latin, but in the diagnosis and scientific treatment of disease, these ancient sophistries should be abandoned.

Guano.—The deposits of guano upon the Chincha Islands are nearly exhausted. The Peruvian Government, however, have commenced shipping from the Guanape Islands, where over one hundred vessels are reported waiting for cargoes. As to the value of the guano from these islands, and the extent of the deposits, there is no reliable information as yet. No analyses have yet been published, and the depth of guano is variously stated from twenty to sixty feet. Should this supply prove temporary, the prospects of the West Indian and North American phosphate deposits will be greatly improved. Guano was first imported into England from Peru, in 1826, the business increasing very rapidly. In 1852, 300,000 tons were sold in the United States and Great Britain. In 1854, the quantity remaining upon the Chinchas was estimated at 8,000,000 tons. This estimate was thought to be much below the actual quantity. It has proved, however, to be not far from the truth.

Important Spectroscopic Observations.—During the eclipse of the sun upon August 7th, Prof. Harkness, at Des Moines, Iowa, and Prof. Winlock, at Shelbyville, Kentucky, observed a number of new lines in the rose-colored protuberances of the sun. The latter observer notes eleven lines in place of five heretofore mentioned. Different spectra were obtained from different protuberances, indicating a variety in composition. These protuberances have been heretofore pronounced, by European astronomers, to be mainly composed of incandescent hydrogen.

A New Polytechnic School.—A party of gentlemen from Louisville, Kentucky, recently made a tour of inspection among the Eastern Colleges, collecting information preliminary to the establishment of a polytechnic department of the Louisville High School. As an educational institution, this school already maintains a higher position than many of the so-called universities and colleges in the United States, and we are glad to chronicle this new movement.

The Trustees of Dartmouth College have voted $25,000 in aid of the building for the Agricultural College.

Mr. George Peabody has given $140,000 for the promotion of science and useful knowledge in the county of Essex, Mass. The gift is placed in the care of trustees named by Mr. Peabody.

The Kent Scientific Institute, of Grand Rapids, Mich., propose to execute a geological survey of Kent and the adjoining counties during the next two years.

AMERICAN DRUGGISTS' PRICE-CURRENT—NEW YORK.—JOBBERS' PRICES.

DRUGS AND CHEMICALS.

Aceton	per oz		to		35
Acid, Acetic, No. 8	per lb		to		18
sp. gr. 1,047 U.S.P.	per lb		to		28
Chemically Pure	per lb		to		55
Glacial	per lb		to	1	60
Benzoic, German	per oz		to		30
Boracic, pure	per lb		to		85
Citric	per lb		to	1	20
Fluoric, 1 lb bottles	per lb		to	2	30
Formic	per lb		to	3	00
Gallic	per lb		to	3	00
Hydrophosphorous	per lb		to	4	25
Lactic	per lb		to	4	25
Muriatic, 18 degrees	per lb		to		5
chemical pure	per lb		to		35
Nitric, 38 degrees	per lb		to		15
chemical pure	per lb		to		38
Oxalic, patent	per lb		to		35
Phosphoric, glacial	per lb		to	3	00
Prussic	per oz	8	to		9
Sulphuric	per lb	4	to		5
chemical pure	per lb		to		50
Valerian	per oz		to	1	40
Tartaric, powdered	per lb		to		84
Aconite Leaves	per lb		to		28
Aconitia	per dr		to	5	00
Agaric Alba	per lb		to		80
Alcohol, 95 per ct	per gal		to	2	60
Aloes, Cape, powdered	per lb		to		36
Socotrine, powdered	per lb		to	1	15
Alum, Roman	per lb		to		11
lump	per lb		to		4½
Ambergris, gray	per oz		to	14	00
Ammonia Carbonate, bulk	per lb		to		25
in jars	per lb		to		26
Muriate	per lb		to		16½
Ammonia Aqua, 20 degrees	per lb		to		12
26 degrees	per lb		to		22
Hypophosphite	per lb		to	4	00
Oxalate	per lb		to	2	00
Phosphate	per lb		to	2	00
Sulphate	per lb		to		10
Ammonium Valerian. Crystals	per oz		to	1	30
Ammonium Bromide	per lb		to	2	50
Hydrosulphuret	per lb		to		75
Iodide	per lb		to	8	50
Amygdalin	per oz		to	3	75
Antimony and Potass	per lb		to	1	10
Butter	per lb		to		80
Arnica Leaves	per lb		to		20
Arrow Root, Bermuda	per lb		to		45
St. Vincent	per lb		to		18
Arsenic, white powdered	per lb	8	to		10
red pulv	per lb		to		30
red, lump	per lb		to		20
Arsenic Solution, Fowler's	per lb		to		16
Iodide	per oz		to		90
Sol., Donovan's	per lb		to		30
Asbestos	per lb		to		15
Asparagin	per oz		to		
Atropia	per dr		to	3	25
Sulphate	per dr		to	3	25
Valerian	per dr		to	4	50
Balsam Fir	per gal		to	4	00
Copaiva	per lb		to	1	10
Peruvian	per lb		to	6	00
Tolu, true	per lb		to	1	35
Barbadoes Tar	per lb		to		12½
Bark, Elm	per lb	18	to		
Bark, Calisaya, quill	per lb		to	1	65
Red, quill	per lb		to	1	90
Pitayo	per lb		to		80
Cascarilla	per lb		to		25
Mezereon	per lb		to		28
Sassafras	per lb		to		10
Baryta Muriate	per lb		to		30
Nitrate	per lb		to		40
Bay Rum	per gal		to	3	25
Bebeerin, pure	per oz		to	5	50
Sulphate	per oz		to	3	50
Belladonna Leaves	per lb		to		25
Bicarbonate Soda	per lb		to		7
Bichromate Potash	per lb		to		23
Bismuth Metallic	per lb		to	8	50
and Ammonia Citrate soluble	per oz		to		90
and Ammonia Citrate Solution	per lb		to	1	30
Oxychloride	per lb		to	7	25
Subcarbon	per lb		to	8	25
Sub-Nitrate	per lb		to	7	25
Tannate	per oz		to	1	50
Valerianate	per oz		to	2	40
Black Drops	per lb		to	4	75
Blue Mass	per lb		to		58
Bole, Armenia, true	per lb		to		10
Borax, refined	per lb		to		40
Brimstone, roll	per lb		to		5
Bromine	per lb		to	3	00
Brucia	per oz		to	8	75
Buchu Leaves, long	per lb		to		60
short	per lb		to		33
Burgundy Pitch, true	per lb		to		15
Cadmium, Bromide	per oz		to		50
Iodide	per oz		to		65
Metallic	per lb		to	4	40
Sulphate	per lb		to	7	50
Caffeine	per oz		to	9	00
Calcium Chloride	per lb		to		90
Iodide	per lb		to	8	50
Calisaya Bark, Milhau's Original Elixir of	per doz		to	11	00
" " "	per gross		to	120	00
Calisaya Bark, Milhau's Chalybeate Elix. of	per doz		to	11	00
" " "	per gross		to	120	00
Calomel, Hydrosub	per lb		to	1	00
Camphor, Refined	per lb		to	1	00
Cannella Alba	per lb		to		28
Cantharides, powdered	per lb		to	2	40
Carbolic Acid crystals	per oz		to		17
" " solution	per lb	60	to		85
" " " common	per lb		to		35
Carbon Bi-Sulphuret	per lb		to		42
Cascarilla Bark	per lb		to		25
Cassia Buds	per lb		to	1	15
Castor Oil	per gal		to	2	90
Caustic Soda	per lb		to		9
Centaury Minor	per lb		to		38
Cerium, Oxalate	per oz		to	1	15
Nitrate	per oz		to	1	60
Chalk, Precip., English	per lb		to		23
Cherry Laurel Water	per lb		to		58
Chlorate Potass, English	per lb		to		50
Chloride Lime	per lb		to		8
Chloroform	per lb		to	1	35
Cinnamon, Ceylon, true	per lb		to	1	75
Citrine Ointment	per lb		to		58
Civet	per oz		to	5	50
Cobalt	per lb		to		26
Cocculus Indicus	per lb		to		38
Cocoa Butter	per lb		to	1	00
Codeine	per dr		to	2	50
Cod Liver Oil	per gal		to	2	25
Cod Liver Oil, ("Shore Oil")	per gal		to	2	15
Cod Liver Oil, J. C. Baker & Co.'s	per doz		to	8	00
" " "	per gross		to	90	00
" " " ...5 gross, per gr			to	87	00
Cod Liver Oil, Hazard & Caswell's	per doz		to	7	50
" " "	per gr		to	90	00
Cod Liver Oil, Milhau's Golden	per doz		to	7	00
" Milhau's, Etherized	per gross		to	78	00
Cod Liver Oil, Milhau's, with the Hypophosphite of Lime	per doz / per gross		to	7 / 84	50 / 00
Collodion	per lb		to	1	65
Cantharidal	per doz		to	4	50
Colocynth, powdered	per lb		to		75
Confectio Rosæ	per lb		to		48
Sennæ	per lb		to		48
Conium Leaves	per lb		to		25
Coniin	per oz		to	7	50
Copper Ammoniated	per lb		to	1	20
Black Oxide	per lb		to	2	20
Carbonate	per lb		to	2	20
Sulphate, pure	per lb		to		88
Copperas	per lb		to		4
Corrosive Sublimate	per lb		to		95
Cream Tartar, powdered, pure	per lb		to		47½
Cubebs	per lb		to		88½
Cubebin	per dr		to		25
Cuttlefish Bone	per lb		to		28
Digitalis Herb	per lb		to		18
Digitaline	per dr		to	8	65
Dover's Powder	per lb		to	2	90
Dragon's Blood, mass	per lb		to	1	00
reeds	per lb		to	1	10
Dulcamara Stems	per lb		to		18
Emetine	per oz		to	8	65
Emery Corn	per lb		to		11
Flour	per lb		to		8
Epsom Salts	per lb		to		4½
Ergot, new	per lb		to	1	80
Ergotine	per oz		to	1	15
Ether, Acetic	per lb		to		82½
Butyric, concentrated	per lb		to	4	00
Butyraceous	per lb		to	1	75
Chloric	per lb		to		87½
concentrated	per lb		to	1	50
Formic	per lb		to	4	00
Sulphuric	per lb		to		75
washed	per lb		to		80
concentrated	per lb		to		95
Extr. Jockey Club, Chiris	per lb		to	8	65
Extr. Ess. Bouquet, Chiris	per lb		to	3	75
Extr. Banana, superior	per lb		to	1	25
Extr. Orange, superior	per lb		to	1	25
Fluor Spar	per lb		to		16
Flowers, Althea	per lb		to		42
Arnica	per lb		to		22
Borrage	per lb		to		95
Chamomile, German	per lb		to		40
Chamomile, Roman, 1867	per lb	86	to		88
Lavender	per lb		to		9
Malva, large	per lb		to		40
small	per lb		to		45

Flowers, Rosemary	per lb		to	70
Tiliae	per lb		to	70
Violet	per lb		to	68
Fusel Oil, purified	per lb		to	2 00
Ferro-Phosphorated Elixir of Calisaya Bark, Hazard & Caswell's,	per doz		to	12 00
	per grs		to	144 00
Gamboge	per lb		to	1 20
Gelatine French Pink	per lb		to	1 45
Gelatine, White French	per lb	85	to	1 00
Cox's	per doz		to	2 50
Ginger, Jamaica, bleached	per lb		to	29
Ginseng	per lb		to	85
Glauber Salts	per lb	3	to	4
Glycerine, common	per lb		to	35
concentrated	per lb		to	50
"Bowers"	per lb		to	80
"Price's"	per lb		to	1 15
Glycerole Hypophosphite	per lb		to	1 75
Grains D'Ambrette	per lb		to	60
Paradise	per lb		to	30
Gum Acroides	per lb		to	24
Amber	per lb		to	50
Ammoniac	per lb		to	60
Arabic, Turkey, sorts	per lb		to	55
1st picked, Trieste	per lb		to	95
2d " "	per lb		to	75
3d " "	per lb	55	to	60
Barbary	per lb		to	40
Assafœtida	per lb	65	to	
Benzoin, common	per lb		to	70
prime	per lb		to	90
white marbled	per lb		to	1 00
Copal, Accra	per lb		to	
Benguela	per lb		to	30
Kowrie	per lb		to	45
Damar, Batavia	per lb		to	60
Singapore	per lb		to	55
Elemi, Aromatic	per lb		to	55
Euphorbium	per lb		to	25
Galbanum	per lb		to	1 00
strained	per lb		to	1 25
Gedda	per lb		to	28
Guaiacum	per lb	50	to	
strained	per lb		to	55
Kino	per lb		to	60
Mastic	per lb		to	4 25
Myrrh, Turkey, powdered	per lb		to	70
Olibanum	per lb		to	30
tears	per lb		to	40
Sandarac	per lb		to	65
Shellac, Campbell's D. C	per lb		to	55
Garnet	per lb		to	52
No. 2	per lb		to	45
Native	per lb		to	45
Senegal	per lb		to	50
Tragacanth, common	per lb		to	50
flake	per lb	1 30	to	1 50
flaky sorts	per lb		to	60
Harlem Oil, Dutch	per doz		to	50
Hoffman's Anodyne	per lb		to	48
Hydriodate Potash, Atkinson's	per lb		to	5 25
Conrad's	per lb		to	5 10
Hyoscyami Leaves	per lb		to	26
Hypophosphite Ammon	per lb		to	3 60
Iron	per lb		to	8 25
Lime	per lb		to	3 50
Manganese	per lb		to	14 00
Potash	per lb		to	8 50
Soda	per lb		to	3 50
Iceland Moss	per lb		to	10
Indian Hemp, true	per lb		to	1 00
Insect Powder, true	per lb		to	1 10
Iodine, Resublimed	per lb		to	6 75
Crude, in bulk	per lb		to	6 50
Irish Moss	per lb		to	10
Iron, Alum	per lb		to	1 60
by Hydrogen	per lb		to	2 50
Carb. Proto	per lb		to	45
Precip	per lb		to	25
Citrate and Ammonia	per lb		to	1 45
Magnesia	per lb		to	1 35
Quiniæ	per lb		to	10 00
Strychnine	per lb	10 00	to	12 50
Hypophosphite	per lb	8 40	to	8 50
Iodide	per lb		to	8 25
Syrup	per lb		to	80
Lactate	per lb		to	3 25
Phosphate, Precipitate	per lb		to	67
Pyrophosphate	per lb		to	1 75
Syrup	per lb		to	65
Sesquichloride	per lb		to	1 45
Sol	per lb		to	60
Sesquinitrate	per lb		to	44
Subsulphate	per lb		to	1 70
Sulphate, pure	per lb		to	9
Exsiccat	per lb		to	17
Sulphuret	per lb		to	31½
Superphosphate Syrup	per lb		to	65
Tannate	per lb		to	6 60
India Ink	per lb		to	1 75
Isinglass, American	per lb		to	1 15
Russian, true	per lb		to	6 50
Juniper Berries	per lb		to	6
Juniper Tar Soap, Hazard & Caswell's	per doz		to	3 75
Kreosote, white	per lb		to	1 15
Lactucarium	per oz		to	75
Lead Acetate, pure	per lb		to	90
Licorice Paste, solid	per lb		to	40
Sicily	per lb		to	80
Calabria	per lb		to	44
Imitation	per lb		to	37
Barracco	per lb		to	43
P. S	per lb		to	44
Lime, Carbonate, Precipitate	per lb		to	22
Hypophosphite	per lb		to	3 75
Iodide	per lb		to	8 50
Phosphate, Precipitate	per lb		to	40
Sulphite	per lb		to	31
Lime Juice	per gal		to	1 50
Lint, Taylor's	per lb		to	1 80
Lapis Calaminaris	per lb		to	8
Laurel Berries	per lb		to	12
Leaves	per lb		to	12
Liquid Styrax	per lb		to	60
Long Pepper	per lb		to	90
Lunar Caustic, pure	per oz		to	1 30
67 per cent., N. S	per oz		to	90
Lycopodium	per lb		to	60
Magnesia Carbonate	per lb		to	42
Calcined	per lb	95	to	1 20
ponderous	per lb		to	1 80
Citrate	per lb		to	1 75
Sulphite	per lb		to	1 20
Manganese, powdered	per lb		to	8
Saxony	per lb		to	12
Manna, small flake, '68	per lb		to	1 75
large flake, '67	per lb		to	2 50
sorts, new	per lb		to	1 30
Matico Leaves, true	per lb		to	50
Mercury	per lb		to	90
cum Creta	per lb		to	56
Magnesia	per lb		to	1 22
Cyanuret	per lb		to	5 80
Sulphuret	per lb		to	80
Mercurial Ointment (⅓M)	per lb		to	70
(⅓M)	per lb		to	58
Morphia Sulphate	per oz	10 50	to	
Acetate	per oz	10 50	to	11 00
Muriate	per oz	10 50	to	11 00
Valerianate	per oz		to	13 00
Musk, true	per oz		to	16 00
in grain true	per oz		to	32 00
Nux Vomica	per lb		to	14
Oil, Amber, Crude	per lb		to	60
Almonds (Expressed) Allen's	per lb		to	87
Essential, Allen's	per lb		to	24 00
Anise	per lb		to	4 00
Bergamot	per lb	6 00	to	7 00
FF, new crop	per lb		to	6 50
Bergamot, Donner's	per lb		to	7 25
Bergamot,—Sanderson's	per lb	7 50	to	7 75
Cade	per lb		to	1 00
Cajeput	per lb		to	2 00
Camphor	per lb		to	1 75
Caraway	per lb		to	2 75
Seed	per lb		to	5 50
Cassia	per lb		to	3 75
Cinnamon, true	per oz		to	1 25
Citronella, prime	per lb		to	2 87½
Winter's	per lb		to	2 75
Copaiva	per lb		to	3 00
Croton	per lb		to	3 50
Cubebs	per lb		to	4 00
Cummin	per lb		to	10 00
Fennel	per lb		to	3 00
Geranium	per lb	12 00	to	22 00
Chiris	per lb		to	15 00
Prepared	per lb		to	25 00
Turkish	per lb	14 00	to	18 00
Jessamine	per lb		to	3 50
Juniper	per lb		to	1 20
Berries, true	per lb		to	3 50
Lavender, Garden, forte	per lb		to	1 65
fine	per lb		to	1 85
Flowers, Chiris, No. 1	per lb		to	3 75
Lavender Spike	per lb		to	1 00
Laurel, Expressed	per lb		to	90
Lemon, Donner's	per lb		to	4 50
Lemon,—G. R. & Co's	per lb		to	4 50
—Sanderson's (new)	per lb		to	4 50
Lemongrass,—Winter's	per lb		to	5 00
Mace, Expressed	per lb		to	2 50
Marjoram	per lb		to	1 75
Myrrbane	per lb		to	2 00
Neroli Bigarade	per oz		to	4 75
Chiris	per oz		to	4 75
Petit Grain	per lb		to	25 00
Olive, pure	per gal		to	1 75
Marseilles, quarts	per box		to	5 75
pints	per box		to	6 75
Orange	per lb		to	4 00
Origanum	per lb	75	to	1 40
Patchouly	per oz		to	4 25
Pennyroyal	per lb	3 75	to	
Peppermint, pure	per lb		to	5 00
Rhodium	per lb		to	10 00
Rose, Kissaulick	per oz		to	10 00
Rosemary, French	per lb		to	1 75
Trieste	per lb		to	1 15
Chiris	per lb		to	2 25

Oil, Sabine, pure	per lb	to	1 70
Sassafras	per lb	to	1 05
Sesame, Salad, fine	per gallon	to	2 60
Spearmint, Hotchkiss	per lb	to	5 50
Spike	per lb	to	
Succinum, crude	per lb	to	60
rectified	per lb	70 to	1 25
Tanzy,—"Eastman's"	per lb	to	5 00
Thyme, white, pure	per lb	to	2 75
Valerian	per lb	to	18 00
Wintergreen	per lb	to	4 75
Wintergreen, Van Deusen Bros.	per lb	to	4 75
Wormwood	per lb	to	7 00
Wormseed, Western	per lb	to	2 75
Baltimore	per lb	to	3 50
Black Pepper	per lb	to	1 25
Cognac	per oz	to	3 50
Ergot	per oz	to	25
Opium	per lb	to	14 50
Orange Buds or Apples	per lb	to	18
Curacoa Ribs	per lb	to	28
Otto Rose, pure	per oz	to	9 50
commercial	per oz	to	7 00
Peppers, Zanzibar	per lb	to	33
Phosphorus	per lb	to	1 20
Amorphous	per lb	to	3 25
Piperin	per oz	to	1 50
Podophyllin	per oz	to	75
Poppy Heads	per lb	to	25
Potassa, Acetate	per lb	to	75
Bicarbonate	per lb	to	35
Carbonate	per lb	to	20
Caustic, common	per lb	to	65
white	per lb	to	90
Citrate	per lb	to	1 15
cum Calce	per lb	to	75
Hypophosphite	per lb	to	4 25
Permanganate, ordinary	per lb	to	80
Phosphate	per lb	to	2 75
Prussiate	per lb	to	44
Sulphate	per lb	to	16
Tartrate	per lb	to	1 05
Potassium	per oz	to	3 75
Bromide	per lb	to	1 60
Cyanide, fus	per lb	to	75
gran	per lb	to	1 40
Iodide	per lb	to	5 10
Sulphuret	per lb	to	85
Quinine, Citrate, with Iron	per oz	to	85
Sulphate, American	per oz	to	2 50
French	per oz	to	2 45
Quassia, rasped	per lb	to	7
Red Chalk Fingers	per lb	6½ to	7
Red Precipitate	per lb	to	1 15
Resin of Jalap, pure	per lb	to	28 00
Rochelle Salt	per lb	to	53
Roots, Aconite	per lb	to	24
Alkanet	per lb	17 to	18
Althea	per lb	to	22
Angelica	per lb	to	35
Calamus	per lb	20 to	60
Colchicum	per lb	to	20
Colombo	per lb	to	22
Culveris	per lb	to	20
Dandelion	per lb	to	30
Galangal	per lb	to	12
Gentian	per lb	17 to	18
Ginger, Race, African	per lb	to	20
Jamaica, Bleached	per lb	to	29
Golden Seal	per lb	to	30
Hellebore black	per lb	to	16
white, powdered	per lb	to	30
Ipecacuanhæ	per lb	to	3 15
powdered	per lb	to	3 25
Jalap	per lb	to	1 90
powdered	per lb	to	2 20
Licorice	per lb	to	18
Mandrake	per lb	to	15
Orris, Florentine	per lb	to	17
Verona	per lb	to	15
Pink	per lb	to	33
Rhatany	per lb	to	30
Rhubarb, E. I	per lb	2 50 to	4 00
Turkey	per lb	to	24 00
Sarsaparilla, Honduras	per lb	to	56
Mexican	per lb	to	28
Turbeth	per lb	to	60
Valerian, English	per lb	to	55
Dutch	per lb	to	40
German	per lb	26 to	35
Vermont	per lb	to	40
Snake, Virginia	per lb	to	44
Seneca	per lb	to	45
Rose Leaves	per lb	to	2 50
Rosemary Leaves	per lb	to	12
Rubigo Ferri	per lb	to	10
Saffron, American, new	per lb	to	2 75
Spanish, true	per lb	to	17 00
Sago, Pearl	per lb	to	12
Salicin	per oz	to	60
Sal Acetoscella	per lb	to	55
Ammoniac	per lb	to	16
Soda, Newcastle	per lb	to	5
Santonine	per oz	to	1 25
Sassafras Bark	per lb	to	10

Scammony, virg., true	per lb	to	20 00
Seeds, Anise	per lb	to	25
star	per lb	to	55
Canary, Dutch	per bush	to	5 00
Smyrna	per bush	to	5 00
Cardamom, Malabar	per lb	to	4 85
Carui	per lb	to	22
Celery	per lb	to	75
Clover	per lb	to	16
Colchicum	per lb	to	20
Coriander	per lb	to	16
Cummin	per lb	to	30
Fennel	per lb	to	20
Fœnugreek	per lb	to	12
Hemp	per bush	to	2 25
Linseed, American clean	per tierce	to	
rough	per bush	to	2 50
Bombay (gold)	per bush	to	2 50
Calcutta (gold)	per bush	to	2 55
Mustard, brown	per lb	to	16
white	per lb	to	16
Rape	per bush	to	5 25
Timothy	per bush	to	5 00
Worm	per lb	to	28
Seidlitz Mixture	per lb	to	45
Senna, Tinnevelly	per lb	to	28
Alexandria	per lb	to	47
E. I	per lb	to	25
Smalts, Blue	per lb	to	22
Snuff, Lorillard's Maccaboy	per lb	to	78
Coarse Rappee	per lb	to	1 00
Irish High Toast	per lb	to	85
Fresh Scotch	per lb	to	85
Soap, Castile, Mottled	per lb	to	16
White	per lb	to	27
floating	per lb	to	27
Low's Brown Windsor	per grs	to	15 00
Soda Acetate	per lb	to	80
Chlorate	per lb	to	2 15
Chloride, Liquor	per gal	to	45
Citrate	per lb	to	1 00
Hydrosulphate	per lb	to	1 05
Hypophosphite	per lb	to	4 10
Hyposulphite	per lb	to	10
Nitrate, pure	per lb	to	22
Phosphate	per lb	to	31
Pyrophosphate	per lb	to	1 25
Sulphite	per lb	to	32½
Ash	per lb	to	4
Sodium	per lb	to	11 00
Iodide	per lb	to	8 00
Spirit Ammonia	per lb	to	45
Aromatic	per lb	to	48
Lavender	per lb	to	48
Nitre Dulc	per lb	37 to	40
Rosemary	per lb	to	47
Sponges, Bahama	per lb	to	90
Bathing, Formes	per lb	to	4 00
Coarse Brown	per lb	to	60
Fine, medium	per lb	6 00 to	7 00
Surgeon's	per lb	4 00 to	7 00
Zimoca	per lb	2 00 to	3 00
Cup, Turkey	per lb	20 00 to	30 00
Trieste	per lb	4 50 to	18 00
Fine Toilet, bleached	per lb	12 00 to	15 00
Fine Trieste, small	per lb	4 00 to	4 50
Glove	per lb	1 75 to	2 00
Grass	per lb	to	25
Sheep's wool	per lb	1 60 to	1 70
Sur Choix	per lb	to	5 50
Squills	per lb	to	12
St. John's Bread	per lb	to	8
Strontia, Muriate	per lb	to	30
Nitrate	per lb	to	30
Oxalate	per lb	to	1 30
Strychnia, Acetate	per oz	to	3 75
Citrate	per oz	to	75
Nitrate	per oz	to	3 50
Pure, crystallized	per oz	to	3 00
powdered	per oz	to	2 75
Sulphate	per oz	to	4 00
Valerianate	per oz	to	5 50
Styrax Calamita	per lb	to	55
Sugar of Lead	per lb	to	36
Sugar of Milk	per lb	to	58
Sulphur Sublime	per lb	6½ to	7
Tamarinds	per lb	to	10
Tannin	per lb	2 50 to	2 60
Taploca, East India, white	per lb	to	12½
Pearl	per lb	to	15
Tartar Emetic, powdered	per lb	to	90
crystallized	per lb	to	1 10
Tin Foil, thin	per lb	to	45
French, No. 15	per lb	to	80
Tobacco	per lb	to	40
Tonqua Beans, Para	per lb	to	65
Angustora	per lb	to	80
Uva Ursi, American	per lb	to	12
French	per lb	to	18
Vanilla Beans, Bourbon	per lb	13 00 to	16 00
Mexican	per lb	15 00 to	18 00
Venice Turpentine	per lb	to	30
Veratria	per oz	to	5 25
Vitriol, Blue	per lb	to	15
Green	per lb	2½ to	3

Vitriol, White	per lb	to	9
Wax, White,—J. I. Elkens	per lb	to	80
No. 2	per lb	to	77
Phillips'	per lb	to	90
Yellow	per lb	to	50
White Wax,—Leonhardt's	per lb	to	90
Ockmid	per lb	to	85
Sun-bleached	per lb	to	76
White Precipitate	per lb	to	1 50
White Pepper	per lb	to	58
Wine, Colchicum Seeds	per lb	to	1 40
Wood Naphtha	per lb	to	95
Wormwood Herb	per lb	to	20
Yellow Bark	per lb	to	30
Dock	per lb	to	25
Zaffre	per lb	to	1 15
Zinc, Acetate	per lb	to	1 25
Chloride	per lb	to	1 80

DYES AND DYESTUFFS.

Aniline Blue	per lb	to	8 00
Red	per lb	to	8 00
Violet	per lb	to	8 00
Annatto	per lb 1 00	to	1 75
Cochineal, Honduras	per lb	to	1 40
Mexican	per lb 1 30	to	1 40
Cudbear	per lb 28	to	45
Cutch, Pegue	per lb	to	15
Gambier	per lb	to	7½
Indigo, Bengal, fine	per lb	to	3 25
good	per lb 2 50	to	2 75
middling	per lb 2 00	to	2 10
Madras, fine	per lb	to	1 70
ordinary	per lb	to	1 40
Kurpah	per lb	to	
Guatemala	per lb	to	2 00
Caraccas	per lb	to	1 65
Lac Dye, good to fine	per lb 55	to	60
Logwood, Campeachy	per lb	to	2¼
Honduras	per lb	to	2¾
Jamaica	per b	to	2¾
Laguna	per lb	to	2½
St. Domingo	per lb	to	2½
Extract	per lb 16	to	20
" in bulk	per lb 16	to	16½
Lima Wood (gold)	per bbl	to	70 00
Madder, Dutch	per lb 17	to	22
French	per lb	to	23
Nutgalls, Blue, Aleppo	per lb	to	40
Orchille	per lb 30	to	35
Persian Berries	per lb 50	to	55
Safflower	per lb 60	to	65
Sapanwood	per lb	to	15
Turmeric	per lb	to	15
Ultramarine	per lb 28	to	45
Woad	per lb 15	to	16

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials	50	percentage	discount.
German Flint Bottles and vials	30	"	"
Flint Bottles and vials	25	"	"
Furniture Ware	10	"	"
Perfumer's Ware	25	"	"
Chemical Ware	net	"	"
Syringes	10	"	"
Homœopathic vials	10	"	"

NAVAL STORES.

Pitch, City	per bbl	to	4 00
Rosin, Extra Pale	per 280 lbs 8 00	to	
Pale	" 7 00	to	
No. 1	" 5 00	to	
No. 2	" 3 50	to	
Strained	" 3 50	to	
Common	"	to	3 00
Spirits, Turpentine (North Carolina)	per gal	to	50
Turpentine, Soft	per 280 lbs	to	6 00

OILS.

Linseed Oil, American	per gal	to	1 10
English	per gal	to	1 10
Palm Oil	per lb	to	16
Paraffine Lubricating Oil	per gal	to	40
Sperm, Crude	per gal	to	2 10
Sperm, Winter, unbleached	per gal	to	2 20
Lard Oil Prime, City	per gal	to	1 70
Red Oil, City distilled	per gal	to	70
Red Oil, Saponified	per gal	to	78
Whale, Crude	per gal	to	1 15
Whale, Bleached, Winter	per gal	to	1 25

PAINTS (DRY).

Asphaltum, opt	per lb 10	to	12
Barytes, Foreign	per ton	to	45 00
Barytes, American	per lb	to	2
Black Lead	per lb 8	to	12
Black Ivory, drop, fair	per lb 10	to	18
good	per lb 18	to	20
best	per lb 24	to	28
Blue Celestial, good	per lb	to	14
Chinese	per lb	to	1 00
Prussian, fair to best	per lb 35	to	1 00
Ultramarine fair to best	per lb 23	to	45
Chalk, Lump	per lb	to	2¼
China Clay	per lb	to	2½
Chalk	per bbl	to	4 50
Green Paris, fair to best	per lb 35	to	50
Green Chrome, fair to best	per lb 33	to	42
Lamp Black—Coach Painter's—L. Martin & Co.'s	per lb 23	to	25
Lamp Black, ordinary	per paper 8	to	12
Litharge, powdered, American & English	per lb 11	to	11½
Ochre, Yellow, French, dry	per lb 2½	to	4
Red Venetian	per lb 3½	to	5
Red Indian, fair to best	per lb 11	to	18
Red Lead, American	per lb 11	to	12
English	per lb	to	14
Rose Pink	per lb	to	20
Sienna, American	per lb 7	to	9
Italian, B'nt	per lb 18	to	22
Raw	per lb 15	to	20
Umber, Crude, Turkey	per lb 5	to	7
burnt	per lb 8	to	9
Tieman's Calif. Vermillion	per lb	to	1 00
Pure Carmine	per lb	to	14 00
Soluble Blue	per lb	to	1 25
Vermillion, English, pale	per lb	to	1 10
deep	per lb	to	1 10
American	per lb	to	85
Chinese	per lb	to	1 20
Trieste	per lb	to	1 20
White, China	per lb	to	22
Cremnitz	per lb	to	30
Lead, pure	per lb 13	to	14
good	per lb 9	to	11½
Paris	per lb 3½	to	4
Zinc, American	per lb 10	to	12½
Zinc, French	per lb 14	to	16
Whiting	per lb		8

PAINTS (IN OIL).

Black coach	per lb 28	to	30
Blue, Chinese	per lb 90	to	1 00
Prussian, fair to best	per lb 35	to	80
Brown, Van Dyke, fair to best	per lb 20	to	28
Dryer, Patent, American	per lb 12½	to	14
English	per lb 12½	to	15
Green, Chrome	per lb 18	to	27
Imperial	per lb 15	to	18
Paris	per lb 33	to	42
Verdigris	per lb 25	to	63
Putty, in bladders	per lb	to	5½
in bulk	per lb	to	5
Red Venetian, fair to best	per lb 8	to	16
Sienna, burnt, fair to best	per lb 22	to	35
White Lead, English, B. B	per lb	to	16
American, pure	per lb 13½	to	14
good	per lb 11	to	12½
fair	per lb 9	to	10
White Zinc, American	per lb 10	to	13
French	per lb 15	to	15½
Yellow Ochre	per lb 9	to	10
Chrome, fair to best	per lb 16	to	32

SPICES.

Cassia, in mats	per lb	to	70
Cloves	per lb	to	40
Ginger, Race, African	per lb	to	19
Mace	per lb	to	1 60
Nutmegs, No. 1	per lb	to	1 40
Pepper	per lb	to	38
Pimento, Jamaica,	per lb	to	84

WINDOW GLASS.

American Window—1st, 2d, 3d, and 4th qualities.

6	by	8	to	8	by	10	Per fifty feet	$ 6 25 to 3 75
8	by	11	to	10	by	15	"	6 75 to 4 75
11	by	14	to	12	by	18	"	7 50 to 5 50
13	by	16	to	16	by	24	"	8 50 to 6 00
18	by	22	to	18	by	30	"	10 00 to 7 00
20	by	30	to	24	by	30	"	12 50 to 8 00
24	by	31	to	24	by	36	"	14 00 to 9 00
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THE CHEMICAL NEWS.
Vol. V. No. 4. American Reprint.

THE SPECIFIC GRAVITIES OF LIQUIDS AND SOLIDS THEORETICALLY CONSIDERED.

BY DR. J. G. MACVICAR,

MOFFAT, N. B.

It is generally understood that Euclid shaped his Elements expressly to the end that ultimately he might be able to demonstrate the properties of the regular polyhedra, whose importance in every system of morphology he saw clearly; while Plato flew at them directly as the very forms of the elements of Nature. There is, therefore, nothing contrary to the traditions of philosophy in its highest walks in the supposition that the forms of the molecules of bodies, when they have been so far perfected as to have become individualised, possess the forms of the regular polyhedra. Now, if we suppose that the ultimate material element or unit of atomic weight or force is the same in all substances whatever—a supposition which has, also, the highest sanctions of philosophy in its favour, and which, though set aside for a time, begins again to be more and more favourably considered every day—and adopt the law of symmetry as the law by which these units of weight shall aggregate into groups or molecules which shall be more or less stable, we shall be conducted, by the progress of the synthesis, whether we will or no, to these regular polyhedra as the forms and structures in which that synthesis culminates, and especially to the *tetrahedron*, the *icosahedron*, and the *dodecahedron*, which are intimately related to each other.

Nor is there anything to be regretted in this conclusion; on the contrary, it is impossible for any one who has mastered the details of chemistry considered as a science of phenomena, and not of hypothesis, not to perceive—if he will but consent to look at tha twhich implies a great revolution in this science—that this doctrine of polyhedral molecules explains a multitude of facts and phenomena, which, in all the lights the hitherto amorphous chemistry can bring to bear upon them, are utterly dark, and merely matters of wonder.

But, instead of indulging in general statements, let us prove the statement in reference to the weights of bodies, one of their most important physical properties. It will be admitted that the popular chemistry can tell whether a liquid or solid is light or heavy only after having weighed it, either by the hand or the balance. Why a piece of sulphur should weigh less than twice as much as an equal volume of water, while a piece of zinc, whose atomic weight is about the same as that of sulphur, should weigh more than seven times as much, and, indeed, generally, why the weight of any body should be what it is, and not otherwise, chemistry can assign no reason. It has, indeed, a hypothesis of atomic volume by which (though not without continual embarrassments) specific gravities may be calculated; but that atomic volume is itself a function of the specific gravity as ascertained by weighing the substance; it is, therefore, merely a complication, not an explaination.

Now, the molecular philosophy which is here advocated solves the problem of specific gravities in the most satisfactory manner; for it does so not by introducing any new formula on this subject into science, but solely by the extension to liquids and solids of the law by which the specific gravities of aëriforms have been calculated ever since the days of Gay Lussac. Having found the right molecules which constitute liquids and crystals (the regular polyhedra, namely), it shows that their volumes tend to be equal, and either actually are equal or in a simple ratio to each other, just as has been long ago found in the case of aëriforms.

I have had occasion already to name sulphur: I will show the truth of what I have now affirmed in reference to sulphur and its companion oxygen, two elements which, after hydrogen itself, are the first to show themselves in our synthesis of the elements.

In the nascent state, they are so related morphologically that they may be viewed as the complements of each other, and the reciprocal forms of the same materials. They have accordingly in this their primal state the same atomic weight, and that is 8 when hydrogen is taken as unity. But so defective is the single atom of oxygen in a proper length of axis that, as often as two meet in the same neighbourhood, they must, under the law of symmetry, couple on the same axis; and thus the unit volume of oxygen gas will weigh $2 \times 8 = 16$ when $H = 1$. Similarly so defective is the single atom of sulphur (which, to prevent confusion, we may call sulph) in its equatorial region that each atom must tend to fix three others into this region; so that sulph is to be expected in nature usually in tetratoms, the atomic weight of the tetratom being 4×8 32, which is an atom of sulphur, a state of things which it will be desirable to indicate in symbols, thus—

The tetratom of sulph, $S_4 = \mathbb{S}$, one atom of sulphur.

And here I may remark that, in constituting the tetratom, the atom of sulph has come to constitute a form which is more highly oblate or negative than the single atom was prolate or positive; so that in order to lengthen the axis, tetratoms, when rising into the aëriform state, tend to form unit volumes, not consisting of two atoms merely, as in the case of normal oxygen gas, but three, as in the case of that ozone which weighs $1\frac{1}{2}$ times as much as oxygen gas; a mode of association being normal in the case of suphur (except at a high temperature, which is exceptional in the case of oxygen.

If it be asked how do I come to know, or, at least, to believe, all that, the answer is that I have done so by thinking upon the subject during the leisure of a lifetime, keeping thought all the time abreast of the phenomena of nature and the laboratory. You say it is all a mere imagination, not entitled to the regard of men of science. Well, if you say so after having given this communication a fair reading to its close, I shall leave you, without further molestation, to the free enjoyment of your opinion.

I am now to deduce *à priori* the specific gravity of sulphur and its well-known combinations with hydrogen and oxygen. It is necessary only to premise further that of the two orders of forms—the trigonal and the pentagonal—under one or other of which all terrestrial elements are included, sulphur and hydrogen belong to the trigonal, oxygen and most other elements to the pentagonal. Hence, sulphic and sulphuric molecules and those in which atoms of hydrogen are centrad, must be icosahedral or tetrahedral, for, in these polyhedra, the facets are triangles, while oxygen and most other elements tend to form dodecahedral molecules, for in these the facets are pentagonal. With regard to water, whose molecule gives the unit volume for specific gravities, it is doubly trigonal (hexagonal), whence

[English Edition, Vol. XX., No. 506, page 61.]

it tends to stretch out into laminæ rather than to turn round into molecules; and to constitute one particle of water no fewer than 36 atoms of vapour are required, the atomic weight of the aqueous unit consequently being $36 \times 9 = 324$, when H = 1. No doubt without such evidence as I cannot here reproduce, you will refuse to believe all this. But you will perceive that this reference to the weight of the unit volume of the aqueous element is not necessary to substantiate the fact of my being able to deduce the relative weights of liquids and solids. It is only necessary to enable me to present specific gravities in the usual form, that is, in relation to water as unity. And here I may mention that in giving specific gravities it is usually unnecessary to go beyond the second decimal place, because even it depends on the temperature of the experimental determination as also on peculiarities of internal molecular structure and action which we cannot enter into.

Sulphur.—Its atomic weight is 32; its form is of the trigonal order. Its molecule of culmination is therefore icosahedral, and its volume may be inferred to be normal, that is, equal to the unit volume of water, which is the great assimilative agent on the terraqueous globe. This gives—

$$\text{Sulphur } G = \frac{\text{S}_{20}}{\text{AQ}} = \frac{20 \times 32}{324} = 1{\cdot}96. \quad \text{Exp.} \quad 1{\cdot}96. \quad 2{\cdot}0$$

Here, then, we deduce the specific gravity of sulphur, as found by the balance. I have shown also that the dimorphism of the crystals of sulphur and its plasticity, when fixed by sudden cooling under molecular change at a certain temperature, are involved in the form of this element.

Hodrosulphuric Acid.—The form of the atom of sulphur being oblate or negative, it comes to pass that, in order to lengthen its axis, it must tend to fix an atom of hydrogen on each pole, giving $\text{HSH} = \text{H}_2\text{S}$, which is the well-known formula of sulphuretted hydrogen. Now, of this combination, as of sulphur itself, the molecule must be icosahedral, for an atom of H must be centrad, and H is trigonal as well as S. But the molecule, consisting as it does of 20 parts, and with three elements stuck into the axis of each, must be much larger than merely the icosatom of sulphur. Allowing, then, to this molecule that which after one in simplicity of ratio comes next to one, viz., two normal or aqueous volumes, we obtain for—

$$\text{Hydrosulphuric solid } G = \frac{(\text{HSH})_{20}}{2\text{AQ}} = \frac{20(1+32+1)}{2 \times 324} = 1{\cdot}05$$

Now this fœtid gas when forced down into a liquid has been estimated at 0·9, and the solid has been found to sink in the liquid. Our theoretical specific gravity may therefore be regarded as accurate. But in these forced liquids and solids it is impossible to know how much aëriform matter may be included in them, increasing their bulk without a proportional increase of weight. For this reason I shall pass lightly over sulphurous acid also. Our theory gives 1·58 as its specific gravity. The liquid has been estimated at 1·45, and the solid was seen to be heavier. The theoretical number may therefore be accepted.

Sulphuric Acid, or Anhydride.—The combination SO_3 of the most modern notation is $\text{S}_4\text{O}_6 = \text{SO}_6$ of ours. Its form is so oblate that if two come into the same neighbourhood they must couple, giving $\text{SO}_{12}\text{S} = 2\text{SO}_3$ Auct. And here we obviously have the proper molecule of oxygen, namely, the dodecatom as the body of the combination, carrying a tetratom of sulph or an atom of sulphur on each pole differentiating that dodecatom. Now, these molecules are so large that if they were to form into icosatoms, as their trigonal poles would oblige them to do, they would be out of all keeping with the unit volume of water. Rather than the last of the trigonal series of polyhedrons, then the icosahedral, let us expect the first, viz., the tetrahedral molecule; we thus obtain—

$$\text{Sulphuric acid } \frac{(\text{SO}_{12}\text{S})_4}{\text{AQ}} = \frac{4(32+96\times32)}{324} = 1{\cdot}97. \quad \text{Exp.} \quad 1{\cdot}97.$$

The tetrahedral molecule presents itself in the case of other analogous substances, that is, differentiated dodecatoms composed in great measure of elements tending to the free or aëriform state. Thus the strongest (monohydrated) nitric acid by doubling the chemical formula, as usual, gives $\text{N}_2\text{O}_{10},2\text{HO}$, which, when written symmetrically, gives—

$$\text{Nitric acid } G = \frac{(\text{HONO}_{10}\text{NOH})_4}{\text{AQ}} = 1{\cdot}55. \quad \text{Exp.} \quad 1{\cdot}55. \quad 1{\cdot}52.$$

But to return to sulphuric anhydride—

Such a structure in the terraqueous globe must necessarily be very restless, and though it is found in nature (taurocholic acid, &c.) as well as has been constructed in the laboratory, the combination of sulphur and oxygen usually stops in the production of sulphates, or, as I should say, sulphurates, which are very finely differentiated, and, therefore, very stable combinations, secure from the further attacks of oxygen by being already covered on the poles by the oxygen of the metallic oxide which enters into their composition. Following the mineralogists in using a dot for an atom of oxygen, some idea of the structure of an element of a sulphurate may be given thus—

$$\text{A sulphurate } .. \quad .. \quad \text{OM}\overset{\cdot\cdot}{\underset{\cdot\cdot}{\text{S}}}\text{MO} = \text{M}_2\text{SO}_4 \text{ Auct.}$$

Their poles being oxygens their molecules must be dodecatoms. And as they have all undergone a severe ordeal these dodecatoms may be expected to be differentiated by the fixing of a single element of the sulphurate on each pole. Taking three of the most familiar sulphates of nature, if you make the calculation you will obtain the following results—

$$\text{Anhydrite } .. \quad G = \frac{(\text{Ca}_2\text{SO}_4)1+12+1}{\text{AQ}} = 2{\cdot}95. \quad \text{Exp.} \quad 2{\cdot}90.$$

$$\text{Celestine } .. \quad G = \frac{(\text{Sr}_2\text{SO}_4)1+12+1}{\text{AQ}} = 3{\cdot}97. \quad \text{“} \quad 3{\cdot}95.$$

$$\text{Barytes } .. \quad G = \frac{(\text{Ba}_2\text{SO}_4)1+12+1}{\text{AQ}} = 4{\cdot}64. \quad \text{“} \quad 4{\cdot}70.$$

It is time to remark, however, that both in nature and the laboratory the atom of sulphur often resolves itself into the four atoms of sulph of which it consists, and thus we have sulphous and sulphic acids as well as sulphurous and sulphuric. The presence of moisture especially assists in this partitionment. Taking sulphuric anhydride as the type in the absence of moisture, then, on the access of moisture to it, an atom of aq may be expected to attack and to fix itself on each of the four summits of the four atoms of sulph which constitute the poles. And after this it is only to be expected that the differentiated dodecatom, now rendered too diffuse, shall break up into four atoms of dihydrated sulphic acid or glacial oil of vitriol, which, therefore, we must regard as the normal or most natural hydrate.

Glacial Oil of Vitriol.—It may be shown that one of its poles is sulphic and the other aqueous. Its

molecule may therefore possibly be either the icosatom, consisting of 20, or the aqueous, consisting of 36 elements. But of these the latter plainly could not endure the high temperature of boiling oil of vitriol. Its molecule therefore must be icosahedral. Now

Glacial Oil of Vitriol $G = \frac{(SO_{32}HO)_{20}}{2A2} = 1{\cdot}79$. Exp. 1·75.

When, however, this acid is produced in the cool of nature, and its stability increased by the incrustation of the molecule by lime, we obtain evidence that the acquaform molecule has been constructed, the sulphocalcic molecule being so large as to occupy four aqueous volumes. Thus—

Gypsum $G = \frac{(CaOSO_3.2HO)_{36}}{4AQ} = 2{\cdot}39$. Exp. 2·3. 2·4.

As to the strongest oil of vitriol which can be obtained by boiling, it has been observed by the best chemists that they cannot drive off the whole of the second atom of the water which is in the glacial acid. It has been observed that, strange to say, just 1-12th of an atom of water remains for every atom of monohydrate obtained. Now, here, when viewed in the light of our molecular morphology there is nothing strange. An atom of moisture has just twelve points or summits to which such bodies as atoms of oil of vitriol could attach themselves. And what has happened under the heat and violence of the long-continued boiling is obviously this, that the icosatoms of the glacial acid have been broken up, and the single elements of oil of vitriol, thus set free, have gathered round particles of moisture as nuclei, each atom of Aq being competent to accommodate 12 atoms of oil of vitriol around it.

That this is the true interpretation of the phenomenon is proved by the specific gravity. Thus—

Strongest oil of vitriol $G = \frac{(SO_3.HO)_{12} + Aq.}{AQ} = 1{\cdot}843$. Exp. 1·843.

That there are sulphurides and sulphides also, as well as sulphurates and sulphates, is shown by the same test.

Sulphuride of zinc $\frac{(Zn\S Zn)\,1+12+1}{AQ} = 4{\cdot}15$. Exp. 4·16.

But the same formula applied to Galena gives G= 10·34, or, possibly, 5·17 if occupying two normal volumes, while the balance gives G=7·4. Now, placing the metal as the body of the molecule and an atom of sulph in each pole (which must give the same percentages on analysis), we obtain—

Sulphide of lead $\frac{(SPbS)_{20}}{AQ} = 7{\cdot}4$. Exp. 7·4.

I only add that selenium comes out as baric, and tellurium as barytic sulphur, and that thallium comes out as one of a series of five metals, of which lead, gold, cadmium, indium, are other members, the body of the atom of thallium being an icosatom of sulph, and the poles atoms of sodium welded on that body.

ON

HEAT TREATED AS A SCIENCE OF KINETICS.*

BY G. F. RODWELL, F.C.S.

(Concluded from Am. Rep., Sept., '69 page 136.)

IV. (Abstract).

This lecture was entirely devoted to radiant heat: the principal definitions are given below.

* A course of four lectures delivered at the London Institution.

If a mass of matter possessing a greater amount of molecular motion than the matter around it (a heated ball of metal, for example) be placed in a space devoid of all directly recognisable matter (a vacuum), it is found that it rapidly loses its motion until it assumes the temperature of proximate surrounding bodies; and, inasmuch as that motion proceeds in straight lines in every direction, like the radii of a circle, the action is known as *radiation*, and the motion thus transmitted as *radiant heat*. (*Radius*, a rod, the spoke of a wheel, related to ραβδος. *Radio*, to emit beams, to shine, is not unfrequently used by the Ancients; thus Lucretius "*rubent radiati lumina solis.*").

It is impossible, *à priori*, that in this case there can be direct transmission of heat by conduction (Lecture III.) or by convection (Lecture III.). The motion is not communicated to visible and readily-recognisable matter, but to that infinitely subtle matter called the *ether* or *interstellar* medium (Αιθηρ of the Ancients—Lecture I.); and it is believed to travel in progressive waves, that is, such waves as are produced when a long cord fixed at one end is rapidly jerked up and down. There is no transference of matter, only of motion; and each particle of the ether actuated by the motion moves at right angles to the direction of transmission. (The belief in the existence of a matter infinitely more subtle than air has pervaded philosophy from the very earliest times; it is distinctly enunciated in several of the oldest systems of Hindoo philosophy, at least 900 years B.C. It appears in Greek philosophy—most notably in that of Aristotle; and many of the Middle Age systems are founded upon this assumption. In the "Materia Cœlestis" of Descartes, we have the ether endued with various properties, inducing conditions of physical change; among others, he has assigned to it the production of all motion, an idea which accords well with Aristotle's derivation of Αιθηρ from αει and θεω. In the "Phlogiston" of Stahl, we have the ether endued with various properties, inducing conditions of chemical change, the chemical phase of the "Materia Cœlestis." In some form or other, the assumption is essential to physical philosophy; for without it all radiant actions would be quite inexplicable. In support of the existence of the ether, we have—(α) Various phenomena connected with light, as has been shown by Euler, Huyghens, Young, and others; (β) the shortening of the path of Encke's comet, the period of revolution of which is 3⅓ years, which is diminished by about 0·11 of a day at each revolution; and it is probable that all the visible motions of the universe are likewise becoming lessened by the same resistance; (γ) the experiment of Foucault on the production of heat by the rotation of a copper disc between the poles of a magnet.*)

Radiant heat is closely related to light; indeed, we have every reason for believing that the motion which constitutes heat is only a slower form of the motion which constitutes light; in a word, that the difference is one of degree rather than of form. Thus, if we heat a mass of metal, it gradually assimilates molecular motion until, at a certain point (*red heat*), it emits light, and the more motion it receives, the more intense does the light become, until at length it emits white light (*white*

* The experiments of Balfour Stewart and Tait on the production of heat by the rapid revolution of a disc *in vacuo* appeared to support the hypothesis of an ether; but a paper in the *Philosophical Magazine*, for this month (January, 1869) traces the production of heat to other causes than ethereal friction. The velocity of an ether particle must be inconceivably great, since it has been calculated by Clausius that the velocity of a particle of hydrogen at the freezing temperature is 6050 feet per second; and the ether must be conceived to be infinitely less dense than hydrogen.

heat). Again, when light is decomposed by a prism, that is, when the various ether waves which, in virtue of difference of oscillation, constitute differently coloured lights, are separated, so that waves of one definite velocity appear in one definite place, it is found that, beyond the slowest waves of light, there are waves of radiant heat of extreme power.

Radiant heat is capable of *reflection* (*reflecto* to turn back); and it obeys the same laws as light. Reflection may be defined as the turning back of the ether waves by molecules which cannot assimulate the motion thus conveyed; as when a cord is fixed to a rigid body, and caused to undulate, the wave which travels along it stops when it reaches the fixed end, and then returns, because the rigid body is incompetent to assimilate the motion which the molecules of the cord convey. [This is well illustrated by causing waves to propagate themselves by rapidly jerking a cord of hemp or india-rubber fixed at one end; the cord may be from 4 to 6 millimetres in diameter; or a small brass chain from 5 to 10 metres in length, may be advantageously employed. It should be fixed horizontally, the room darkened, and a beam of light from the electric or oxyhydrogen lamp should be caused to illumine the path of the chain. Communicated undulations are now seen with great clearness to travel to the fixed end of the chain, and, finding there nothing which can assimilate the motion, to return as a reflected wave. The undulations of a row of particles can be shown by fixing at one end a broad and lengthy band of paper, and communicating undulatory motion, as in the case of the cord. The paper best adapted for this purpose is a kind of thin drawing paper, sold in lengths of 36 feet, and $3\frac{1}{2}$ feet broad. In regard to the mirrors to be used for showing the reflection of heat, it is quite essential to success that their axes should coincide *perfectly* (in the experiment, for example, in which a hot ball of metal is placed in the focus of one mirror, and the bulb of a differential air thermometer or a thermo-pile in the focus of another and distant mirror): this can only be the case when the curves are similar, when their centres are in the same horizontal plane, and when the lines joining the opposite extremities of each curve are parallel. The focus may be indicated to the audience by allowing a cylinder of rays of light, of the same diameter as the mirror, to fall upon it, while some fine dust, such as lycopodium or a little volatilised chloride of ammonium, is diffused in the air in front of the mirror; the precise position for the thermometer in the succeeding experiment of reflected heat is thus indicated. The mirrors should be parabolic, not spherical; that is to say, their surface should be generated by the revolution of an arc of a parabola about its axis, not by the revolution of an arc of a circle about the radius which unites the middle of it to the centre of the circle to which it belongs. The smaller mirrors which are sold in this country for experiments on radiant heat are, for the most part, spherical; but very good parabolic mirrors can be obtained in Paris]

Radiant heat is capable of being *refracted* (*frango*, to break up; akin to ρασσω); that is, the motion of the ether waves may be turned, by their passage through certain media, so as to proceed in a different direction, and in an extended form.

The *absorption* (*absorbeo*, to swallow up, or devour) of heat is the reception of the motion from the ether by molecules of matter. It is thus a reverse action to reflection; for absorption pre-supposes that the molecules of the absorbing body readily assimilate the motion. Such molecules may be represented by small wooden balls suspended in the path of a cord, which latter, when caused to undulate, communicates its motion to the balls. (This action may well be shown by fixing a tense india-rubber cord in such a way that its ends may be free; this can be done by connecting it with four rigid supports by thick strings, which is fastened near each extremity, and passes away to the supports, making an angle of about 60° with the cord. This tense cord represents a row of particles of ether. A leaden ball, about 3 centimetres diameter, is suspended by two strings, so as to cause it to oscillate in one plane, the end of the india-rubber cord being the limit of vibration in one direction—that is, the oscillating ball can be caused to impinge upon one end of the tense cord. At the other end of the cord, and in various positions along its path, small wooden balls, about 3 centimetres diameter, are suspended. When the oscillating leaden ball strikes the tense cord, the latter is thrown into vibration, and communicates motion to the small balls in contact with it, thus illustrating both radiation and absorption; for the lead ball represents a molecule radiating heat (viz., communicating its motion to the ether), while the wooden balls represent molecules absorbing heat (viz., receiving motion from the ether.) These illustrations may appear crude, but they at least assist an audience to realize some more or less obscure molecular actions, and a mere statement of them is scarcely sufficient.)

Of the total radiation of the sun, only $\frac{1}{2,300,000,000}$ths is received by the earth. In one year the amount of heat thus received would liquefy a layer of ice 100 feet thick, covering the entire surface of the earth. With the exception of the energy of tides (that is, the energy derived from the ebb and flow of the tides, which results from the attraction of the moon, and tends to diminish the energy of the earth's revolution), the sun is the source of all our available energy—the energy of food and fuel, of water and air in motion. The most dominant attractive forces against which this energy is exerted are—(α.) *Gravity*, the attraction existing between the masses of matter (Lecture I.); (β) *Chemical affinity*, the attraction existing between dissimilar molecules of matter (Lecture I.); and (γ) *Cohesion*, the attraction existing between similar molecules of matter (Lecture II. and III.) This last,—that is, the energy expended in the internal work of a mass of matter (Lecture III.),—enormous as it is, is obviously unavailable to mankind.

The concluding remarks are given below *in extenso*.

The phenomena of the universe, infinite as they are in variety, in form, in magnitude, and in effect, appear to be almost all produced by the interaction of attractive forces with forces of motion, the former tending to produce conditions of stability, the latter conditions of instability. These forces undergo a ceaseless round of change, in which their form alone is altered, while their actual energy, whether it be kinetic or potential, remains the same; for the sum of the energy of the universe is a constant quantity. Circular motion may become elliptic; elliptic motion may become rectilinear; molecules may possess individual motion, or they may move in groups, or they may be actuated by both motions simultaneously; or, again, they may be influenced in innumerable ways by contiguous molecules, which may lessen their motion in one direction and augment it in another, and may change its form, intensity, character, or duration; but, throughout all

these changes, the actual initial amount of energy is present in some form or other. The changes are precise and definite, and they follow unvarying and immutable laws; does it not, therefore, appear reasonable that the Pythagoreans made the most prominent feature of their philosophy the belief that unity and law and an eternal harmony prevail in the affairs of nature?

In the foregoing lectures we have briefly considered one of the dominant motions of the Universe: and we have seen how it is generated, how it influences matter, and how it passes into other forms. From first to last, we cannot fail to have noticed that it is most inimical to rest; that it ever tends to convert a condition of rest into a condition of, at least, temporary unrest. Indeed, we are almost disposed to regard *it*—a motion of molecules—as a condensed form of the motion of masses, since we have learnt that an increase of warmth in a mass of matter too slight to be felt, truly represents a force competent to lift that same mass to a height of many hundred feet; and the old Parmenidean dogma that heat is the cause of all the motion in the Universe * appears more reasonable than ever before. Not only has heat become a science of kinetics, but physical science itself is daily becoming more kinetic in its character, and there can be no doubt that other of the so-called physical forces besides light and heat will, sooner or later, be resolved into forms of motion. I have before spoken of the physical philosophy of Descartes as, perhaps, the most comprehensive kinetic system which has appeared in the whole history of science; and I am often reminded that, in our treatment of certain branches of science (specially in that of heat), we follow closely in his footsteps; in fact, our modern physical philosophy may almost be called *Neo-Cartesianism*. It is much to be wished that we adopted the Cartesian metaphysics to the same extent, in place of the pernicious Positivism † which now prevails. The philosophic spirit of the age tends towards the establishment of a syncretism between the philosophy of matter and the philosophy of mind; and, while the former has scarcely been elevated by the means, the latter has undeniably been degraded and materialized. A moment's comparison with the Platonic philosophy will convince us of this. The Positivists would have us apply to both mental and physical philosophy the same laws and the same modes of treatment; they would have us believe that only which is capable of direct demonstration; they would make the intellect infallible, and the senses all but infallible, forgetting how utterly relative is all our knowledge, and how we necessarily judge of things more in relation to ourselves than in relation to the great Universe around us.‡ It is a hard, unyielding philosophy, which weakens some of the finer attributes of our nature, and destroys faith; it is a philosophy which engenders intense intellectual pride, for it induces our finite intellect to place itself on a level with Infinite Intellect. Rather than this, I say, let us adopt the Cartesian philosophy, and take, as our first principle of certainty, *Cogito ergo sum.** "To think," says a learned divine of our day, "is to see the chain of facts in creation, and, passing along its golden links, to find the hand of God at the beginning, as we saw his handiwork in its course."† In this spirit did Descartes think; in this spirit did he propound the first proposition of his system—"Cogito ergo sum."

The path of pure and divine philosophy is rugged with mounds which men have raised from time to time in the hope of seeing further than their fellows—back into the past, forward into the future; and many of these contain within them the festering remains of dead philosophies, which the world has buried out of her sight for their very loathsomeness. Albeit travellers often ascend these lofty tombs, allured by the hope of getting a clearer view of the distant land they seek; and, when they reach the summit, they are wearied, the time is far spent, and, as the light of day fades from their eyes, and darkness obscures the road, they lie them down, and rest side by side with the corpse of the philosophy which has seduced them. Almost at the outset of our journey, we pass a neglected mound, upon which the traveller has long ceased to rest; and it bears, in nearly defaced characters, the names of Gorgias and Protagoras. Near it, we see a greater eminence, raised by Socrates, and augmented by Cynics, and Megarics, and Cyrenaics. A very mountain bears the name of Aristotle. Many such mounds we pass; some overgrown with underwood, from which peep the ruins of forgotten shrines; some covered with asphodels and cypresses, some with myrtles and with bays, while others, again, are mere morasses, dangerous to tread upon, and rife with disease. Such an one is seen in a misshapen mound, reeking with decay, and too loathsome to approach; the home of vultures, and of ghouls, and of unclean beasts; and it bears the names of Diderot, La Mettrie.‡ Somewhat near to this, we see an eminence which, although new, is gigantic in its propor-

* Parmenides, of Elea, according to Aristotle, Diogenes Laertius, and others, propounded this idea. It was afterwards adopted by Telesius of Cosenza, and other Middle Age philosophers, and in a modified form by Descartes.

† A good account of the most modern phases of Positivism is given by Ravaisson in his "Philosophie en France au XIXieme. Siècle."

‡ The following extract from the treatise "De Sapientia Veterum" of Francis Bacon would appear to be peculiarly applicable to a certain sect of philosophers of our day. At the same time, we do not wish to give to the word φιλόσοφος the same significance as did some of the Greek Fathers—S. Chrysostom, for example, in his charmingly eloquent Ὁμιλια εις Ευτρόπιον. Pentheus, it will be remembered, hid himself in a wood, in order to be a spectator of the hidden mysteries of a Bacchanalian revel, but, being perceived, he was smitten with a kind of frenzy, one result of which was that he saw everything double, and thus vacillated between the unreal and the real. A detail account of his doings is given both by Euripides and by Ovid, and the force of the following passage will be scarcely realized unless the reader be familiar with one or other of these accounts. "Alia est Penthei calamitas. Qui enim ausu temerario, mortalitatis parum memores per excelsa Naturæ et Philosophiæ fastigia (tanquam arbore conscensa) ad mysteria divina adspirant, iis pœna proposita est, perpetuæ inconstantiæ, et judicii vacillantis, et perplexi. Cum enim aliud sit lumen Naturæ, aliud Divinum; ita cum illis sic, ac si duos Soles viderent. Cumque actiones vitæ et decreta voluntatis ab intellectu pendeant: sequitur etiam ut non minus voluntate, quam opinione hœsitent nec sibi omnino constent: Itaque et duas Thebas similiter vident. Per Thebas enim actionum fines describuntur (cum Thebis Pentheo esset domus et perfugium). Hinc fit, ut nesciant, quo se vertant, sed de summa rerum inc erti et fluctuantes, tantum subitis mentis impulsibus in singulis circumagantur."

* "Sic autem regicientes illa omnia, de quibus aliquo modo possumus dubitare, ac etiam falsa esse fingentes; facilè quidem supponimus nullum esse Deum, nullum cœlum, nulla corpora; nosque etiam ipsos non habere manus, nec pedes, nec denique ullum corpus; non autem ideo nos qui talia cogitamus nihil esse: repugnat enim, ut putemus id quod cogitat, eo ipso tempore quo cogitat, non existere. Ac projinde hæc cognitio, *Ego cogito, ergo sum*, est omnium prima et certissima, quæ cuilibet ordine philosophanti occurrat."—*Principia Philosophiæ*, lib. i., p. 7.

† "The Limits of Philosophical Inquiry," an address delivered to the Members of the Edinburgh Philosophical Institution, on November 6th, 1868, by William, Lord Archbishop of York.

‡ The "Système de la Nature" of La Mettrie is one of the most vilely assumptive and irrational works which has appeared in the whole history of thought. Published during the most gross and rampant period of French materialism, it aimed at the destruction of ideas spiritual, ethical, and philosophical, which have ever been inseparable from the human mind; which have been cherished by races the most diverse in every age and every civilized country. Ideas which belong as much to Koung-fou-tzeu, to Zoroaster, and to the Vedic Brahmans as to Plato, Socrates, and Seneca, or to the thinkers of our day.

tions; it is the resort of innumerable travellers of every race and of every creed, and they help to raise it higher, for they would fain climb to heaven by its means; and upon it we read the name of Auguste Comte. But what graceful peak rears its head sublime above the plain? it pierces the very clouds; it is clothed with amaranths, and it bears upon its summit a fane dedicated to Immortality. Lo! the calm, the sovereign, the ineffable spirit of Plato dwells therein. Here, as *we* travel along the path of philosophy, let us rest; here let us throw down our burden of modern Positivism, and then start afresh, Platonised in spirit and in thought.

PROCESS FOR DETERMINING THE CARBON CHEMICALLY COMBINED WITH IRON.*

BY PROFESSOR EGGERTZ,

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When steel or pig-iron containing carbon in chemical combination is dissolved in nitric acid, a soluble brown colouring matter is formed whose colouring power is quite intense, and the solution assumes a tint which is dark in proportion to the quantity of the chemically-combined carbon.

Iron and graphite (or free carbon) do not influence this colouring; for the solution of nitrate of iron is colourless, or, at most, slightly greenish, unless extremely concentrated, and graphite is insoluble in nitric acid.

Thus, in dissolving two pieces of different steels of the same weight in nitric acid, taking care to dilute the darker solution until the two liquids present exactly the same colour, it is very evident that the more highly carburetted steel will furnish the larger quantity of liquid, and that the proportion of the volumes will indicate the relative proportion of colour in the two steels.

If now the composition and content of carbon of one of the steels is known, the absolute percentage of carbon in the other steel may be immediately deduced.

Suppose that 1 grm. of each of two steels (*a* and *b*) have been dissolved, and that the volumes of the two solutions brought to the same degree of colouring bear the relation to each other $a : b :: 5 : 7$. Knowing that the steel (*a*) contains 1 per cent carbon, you at once deduce that the steel (*b*) contains 1·4 per cent of carbon.

In applying this method of analysis, certain precautions must be taken, which we proceed briefly to point out.

In a cylindrical test-tube, dissolve gradually in the cold 10 centigrammes of wrought-iron, steel, or cast-iron reduced to a fine powder, in 1½ to 5 c.c. of nitric acid of 1·2 specific gravity (about 25° Baumé). The use of nitric acid containing hydrochloric acid must be avoided, because the solution of iron would have a yellow tint.

In proportion as the metal contains more carbon, more nitric acid must be used. After some time, when the chief part of the metal appears to be attacked, place the tube in a water-bath to the depth of about 15 m.m., and warm it to 80° C. In this position, only the lower part of the tube is in contact with the warm water; a movement takes place in the acid which favours its reaction upon the metal; a slight disengagement of carbonic acid from all the particles of carbon may be observed. The operation should always be conducted under the same circumstances as to heat and length of time.

The evolution of gas having ceased (in operating upon steel, the reaction must continue two to three hours), place the tube in a large vase filled with water, to bring the solution always to the same temperature. This precaution is indispensable, because the same liquid is darker when warm than when cold. Afterward, pour off, as exactly as possible, the clear liquid into a graduated burette. Upon the black residue remaining in the tube, pour some drops of nitric acid, and heat carefully over a lamp. If there is no further liberation of gas, the residue consists of nothing but graphite or silica. Cool the new solution, and add it to that which is already in the burette.

The liquid is then diluted with water until its colour corresponds exactly with that of the normal liquid, which latter should be of such a degree of concentration that each cubic centimetre represents 0·0001 grm. of carbon.

If, for instance, this normal liquid is prepared from cast-steel containing exactly 0·85 of one per cent of carbon, 1 decigramme of that steel must be dissolved in 8·5 c.c. of nitric acid; 100 grms. of steel containing 85 centigrammes of carbon would thus be dissolved in 8500 c.c. of the normal solution, 100 c.c. of that solution would represent 1 centigramme of carbon, and, consequently, 1 c.c. of the normal solution would represent 0·0001 grm. of carbon.

The normal solution does not keep, and should be often renewed, since it becomes perceptibly paler even within twenty-four hours. For it, however, may be substituted a dilute alcoholic solution of sugar properly caramelised brought to exactly the same tint; this solution keeps much longer without sensible change.

As 1 grm. of iron cannot readily be dissolved in less than 15 c.c. of nitric acid, it follows that a proportion of carbon less than 0·15 of one per cent* cannot be estimated by means of the normal liquid; but this minimum is seldom found in practice.

If the proportion of carbon exceeds 0·5 of one per cent the ferruginous solution is so concentrated that it has a light greenish tint, which renders its comparison with the normal liquid difficult. In that case, a normal liquid of one-third the strength is prepared by diluting the normal liquid with twice its volume of water; then each cubic centimetre of the liquid represents only one-third of the ten thousandth part of a gramme of carbon. When the proportion of carbon in the specimen to be analysed is very large (as, for instance, in white cast-iron), only 0·5 grm. of the metal must be taken for analysis, and, in that case, half a cubic centimetre of its solution corresponds to a cubic centimetre of the normal solution. If the metal to be analysed contains graphite, the latter must be collected on a filter before the solution is put into the burette.

This method is more exact in proportion as the percentage of carbon is smaller. With an accurate balance, and with suitable arrangements, a great number of determinations of carbon close enough for practice can be effected in a time relatively very short.

All the Bessemer steel made at Edskin, in Sweden, is marked, after hammering (*apres l' étirage*), by figures expressing its hardness, as ascertained by this colour-measuring analysis of Professor Eggertz.

* From the *Bulletin of the Chemical Society of Paris;* translated for the *American Journal of Science* by J. Wharton, Esq.

* O. D. Allen, of the Freedom Iron Works, Pennsylvania, has found it quite practicable, by a modification of this method, to distinguish between iron containing respectively 0·10 and 0·15 of one per cent of carbon.

It is obvious that only burettes of perfectly colourless glass must be used, or, at least, they must all have exactly the same tint.

ON THE

METHODS OF ANALYSIS

AND THE

COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

BY M. GASTON TISSANDIER.

Our object in publishing these memoirs from the *Moniteur Scientifique* is to furnish manufacturers and manufacturing chemists with practical methods of analysing with rapidity and certainty the most important productions of commercial chemistry, and also to give an account of their composition. Special treatises are not wanting containing methods of estimating and separating substances which are subjects of investigation to chemists; but we know of the existence of no collection where the description of a process for analysing such and such a commercial product may be met with. It should be added that the methods here published are not original, and offer nothing in the way of novelty, but are employed by most chemical experts. All that we have done is to make a few trifling modifications in a small number of cases. The efficacy of these processes we can in all cases guarantee by the practice acquired by us three years ago in the *Laboratoire d'Essais et Analyses Chimiques de l' Union National*, where we have already performed more than three thousand experiments of all kinds.

I. On Crude Potashes.

Manufacture of Beet-Root Salts.—Almost all the salts of potash now manufactured are extracted from beet-root, the crude salts or potashes being made by calcining the residues of the evaporation of weak vinegars proceeding from the distillation of molasses. These vinegars were formerly evaporated in copper basins; but the acids developed by too active or imperfect fermentation, or thrown in to hasten decomposition, were found to attack the copper, which soon led to the substitution of wooden vats — an important change, which was first effected by M. Coupier. Not long afterwards, another important step was taken by M. Porion, of Vardrecques, who, in the manufacture of salts, evaporated the vinegar partly by the direct action of fire, and partly by the combustion of the charcoal which exists in the organic substance of the vinegar. The Porion stove, which is now almost universally employed, consists of a long vaulted chamber, having at one end from two to three reverberatory furnaces, and terminating in a chimney, near to which is the tap which turns on the vinegar. This chamber is traversed through its largest extent by a paddle shaft, which agitates the vinegar violently, and causes it to fall in showers into that part of the stove which is subject to the direct action of the flames from the reverberatory furnaces. When the vinegar subjected to this preliminary process is sufficiently evaporated, it is placed upon the sole of the furnaces, where, under the action of the fire and vigorous stirring, it soon assumes a pasty form; after which it quickly takes fire, and becomes itself a source of heat, by means of which fresh quantities of vinegar may be evaporated. Calcination being at an end, the salts are thrown upon the ground, and spread out upon a large space, where a final combustion occurs spontaneously.

The calcination of vinegar residues in the Porion stove requires great intelligence and practice on the part of the operators, on account of the difficulty as well as importance of seizing the proper moment for stopping the calcination. If this latter be carried too far, the potash will melt, thereby producing a substance difficult to lixiviate. The appearance of the melted potash is that of a very hard, close stone, of a light grey colour, veined with white, on concussion giving a dull sound. If, on the contrary, calcination be too soon arrested, the product is a pasty mass, which quickly cools and agglomerates, yielding brown and frothy lixiviums, difficult to treat in refining. The refined products which ensue are never white, but always of a greenish-blue tinge, due to the presence of certain unoxidised or non-volatilised sulphides. The appearance of an imperfectly calcined salt is that of an earthy, brown, close substance, not very hard, tinged throughout with reddish tints, and veined with green and violet lines. If a salt of this kind be wetted, an evolution occurs of the characteristic odour of rotten eggs.

In the preparation of salts, it is most important to remove them from the furnace just at the proper time; and the duration of the calcination varies in accordance with the kind of beet-root employed; thus, when the residue under treatment is that made from Picardy beet-root, which is rich in carbonate of soda, the removal must take place sooner than with residue from the beet-root of Artois.

The disposition of the salts in the heaps where combustion takes place also requires careful superintendence; because, if a heap gets too hot, the potash will run; and if, on the other hand, the temperature does not rise enough, the potash will be imperfectly separated. Salts rich in carbonate of potash are heaped in beds from 30 to 50 centimetres thick; the poorer salts in beds of 2 metres thickness.

A well-made salt ought to present the appearance of a porous stone, very light, friable, and sonorous as pumice-stone; its prevailing colour should be greyish red. Salts contain alkaline carbonates, chlorides, sulphates, substances insoluable in water (charcoal and carbonate of lime); also small quantities of sulphates, and, accidentally, cyanides, sulphides, silicates, ammonia, &c.

Mode of Analysis.—The sample to be analysed should be pounded and sifted. About 30 grms. must be taken and finely pulverised in a porcelain mortar 25 grms. of this impalpable powder are weighed off, and placed in a flask capable of holding 500 grms., and containing about 200 grms. of distilled water; it is then boiled for a quarter of an hour, and left to settle, that the insoluble substances may collect at the bottom of the vessel. The clear lixivium is decanted upon a filter placed on a measuring-glass, gauged to ½ litre. The insoluble substances are again treated with cold water, and so on, for three or four times. Lastly, the insoluble substances are thrown upon the filter, and washed with boiling water until the filtered lixivium occupies exactly the volume of ½ litre. This lixivium, when cool, is stirred until it becomes homogeneous, and divided, by means of a pipette, in the following way:

1. Deduct 100 c. c. (corresponding with 5 grms. of

salts), in order to obtain the alkalimetrical standard; these 100 c. c. must be transferred to a ½ litre flask.

2. Another 100 c. c. to be poured into a ½ litre glass, to estimate the sulphuric acid.

3. Fifty c. c. (equal to 2 grms. 5 decigrammes) of salts to be poured into a stoppered bottle of 250 c. c., to estimate the chlorine.

4. Ten c. c. (equal to 5 decigrammes) to be poured into a porcelain capsule of 200 c. c., to estimate the potassium.

Insoluble Substances.—These must be dried at 100°, removed from the filter, and weighed. By calcining them, and weighing the ashes, the proportion of charcoal and organic matter will be obtained by difference.

Determination of the Alkalimetrical Standard.—A standard liquid must first be prepared containing exactly 100 grms. of sulphuric acid per litre (SO_3HO). For the preparation of this liquid, we refer to chemical treatises, only remarking that it should be carefully tested before use. This may be done either by taking as a standard perfectly dry and pure carbonate of soda, or by estimating the sulphuric acid contained by means of chloride of barium. A graduated alkalimetrical measure is filled with the liquid, which is poured, after the addition of a few drops of litmus solution, into the phial containing the 100 c. c. of lixivium or 5 grms. of salts. When the solution has become purple, it is boiled, in order to remove the carbonic acid, and then recovers its original blue colour. Fresh quantities of sulphuric acid are now added, and it is again boiled. This is repeated until the addition of another drop of standard liquid causes the solution to turn from blue to vinous red, and boiling fails to restore it to blue. By reading the number of divisions corresponding to the volume employed of standard liquid, the alkalimetric standard is obtained: thus, if 44 divisions, or 44 cubic demi-centimetres, are used, the standard will be 44°.

Estimation of Chlorine.—One of the best processes for estimating chlorine in potashes is the employment of a standard silver liquid and a solution of neutral chromate of potash. 47·886 grms. of fused nitrate of silver are first dissolved in distilled water, and then diluted so as to form a liquid 1 litre in quantity. 1 c.c. of this liquid will precipitate 1 centigramme of chlorine. Several cubic centimetres of a saturated solution of chromate of potash are poured into the flask containing 50 c.c. of saline lixivium; and the silver liquid is then added, drop by drop, by means of a measure graduated in tenths of cubic centimetres, until the lixivium, augmented by the chromate of potash, turns red. If 14 c.c. of silver liquid, or 140 divisions, be used, 2·5 grms. of the salts will be found to contain 14 centigrammes of chlorine, reckoned in the summary as chloride of potassium.

The chromate of potash may be dispensed with; in that case, the portion of lixivium in which the chlorine is to be estimated is acidulated by pure nitric acid; the standard silver liquid is poured immediately into it, and the precipitated chloride of silver collected at the bottom of the vessel by quick stirring. The exact quantity of silver necessary to precipitate all the chlorine is easily ascertained; and care must be taken to stir the precipitate whenever fresh drops of the silver liquid are introduced. With practice, this method will be found as quick and accurate as the preceding.

Estimation of Sulphuric Acid.—This may be effected by means of chloride of barium. The 100 c.c. of lixivium are acidulated with pure chlorhydric acid, and chloride of barium is added. The precipitated sulphate of baryta is allowed to settle for twelve hours, and need then only be collected on a filter, washed with boiling water, and weighed after desiccation and calcination.

Estimation of Potassium.—By means of bichloride of platinum, the potassium is deposited under the form of chloroplatinate of potash. The 100 c.c. of lixivium corresponding to the 5 centigrammes of salts are acidulated with pure chlorhydric acid; an excess of bichloride of platinum dissolved in water is added in the same capsule, and the whole is then evaporated almost to dryness in a water-bath; at the same time it is very important not to desiccate the precipitate, which, when taken out of the water-bath, should be moistened with at least 1 c.c. of liquid. On attaining this point, it is washed by decantation with ethereal alcohol (4 volumes of alcohol at 40°, and 1 of ordinary sulphuric ether), and thrown upon a small filter. It is again washed upon the filter with a small quantity of ethereal alcohol, dried at 100° in the water-bath, carefully removed from the filter, and weighed in a sensitive balance. It answers to the formula $KCl,PtCl_2$, and the amount of potassium contained in it may be easily calculated. Some chemists do not filter the chloroplatinate of potassium, but wash it by decantation in a vessel of Bohemian glass, where it is evaporated, and dry it in the same vessel in the water-bath. The very light precipitating vessel is tared before the operation, and, by weighing it together with the contained precipitate, the difference obtained is the weight of the latter. In treatises on chemistry, the chloroplatinate of potash is generally recommended to be filtered on a tared double filter—an unnecessary precaution with the proportions here mentioned. When the quantity of salts employed is 5 decigrammes, the precipitate obtained always weighs about 1 grm.; and the amount of substances which adhere to the paper is quite insignificant. To effect this process under good conditions, the best plan is to use a standard solution of bichloride of platinum, in order to be certain beforehand of using neither a too weak nor too powerful reagent. The platinum may be dissolved in the state of sponge by means of aqua regia, in the proportion of 60 grms. per litre, and diluted with water after evaporation: 10 c.c. of this liquid will be required to estimate the potassium.

Moisture.—The moisture contained in a salt may be estimated by drying 5 grms. on a stove, heated to 120°, failing which a small closed tube may be used, into which 5 grms. of salts are placed, and dried over a jet of gas, the water condensed at the upper end of the tube being soaked up with a plug of filtering-paper. The tube is weighed empty, and again with the desiccated portion of the salt, and the difference given is the proportion of water.

Calculation of the Analysis.—The estimated chlorine is transformed into chloride of potassium, the sulphuric acid into sulphate of potash. The quantity of potassium contained in the chloride and sulphate is calculated, and then deducted from the total of potassium yielded by the chloroplatinate. The excess of potassium is transformed into carbonate of potash. The standard corresponding with the carbonate of potash is calculated, and subtracted from the total standard, and the excess of the standard is transformed into car-

bonate of soda. The form of the analysis is drawn up in the manner indicated below.

Phosphates are sometimes contained in salts, but in small quantities, and, in analyses for purposes of manufacture, it is generally useless to pay any attention to them.

The mode of analysis here described gives very precise results; and, when practice has been acquired, the separation of potassium and sodium occurs with great exactitude. It has been proposed to separate the potassium by means of tartaric acid; but we believe that this process would be neither so practical, nor so rigorously exact as the one we have described, whilst with the *natrometer* its results would be merely approximative.

In the course of three years, more than 1000 specimens of salts and refined potashes have been analysed by us, an example of which we subjoin below.

Composition of Beet-root Salts.

Substances estimated.	From l'Aisne (1). I.	From the Somme (2). II.	From the environs of Lille (Nord). III.	From the environs of Lille. IV.	From l'Aisne (3). V.	From the Nord. VI.
Moisture	4·00	2·59	3·48	7·72	2·47	1·19
Insoluble matter	13·50	10·61	14·02	12·08	11·60	13·11
Chloride of potassium	18·86	15·10	20·48	33·76	10·28	29·82
Sulphate of potash	5·71	11·62	11·20	5·75	3·83	2·97
Carbonate of potash	44·28	44·70	24·72	17·00	53·50	36·50
Carbonate of soda	13·48	15·28	26·01	23·50	8·18	16·20
Non-estimated and loss	0·17	0·10	0·09	0·19	0·14	0·21
Total	100·00	100·00	100·00	100·00	100·00	100·00

(1). Product manufactured by the Societé des Usines de Montjean et Channy; MM. Bayard de la Vingtrie, Frères, et Cie.

(2). Ham Distillery (Somme), MM. Hurbain-Désormeaux.

(3). MM. Gunguiêz et Cie., Bucy-le-Long, near Soissons.

Specimens No. 1 and 2 may be considered as types of salts of good quality. No. 5 is one of the richest with which we have met, and Nos. 3 and 4 are the poorest. The composition of the crude potashes varies extremely, as is self-evident, each constituent element occurring in different proportions in the various examples. We have been asked by some chemists why the composition of salts has been thus formularised, and how we could prove that they did not contain, say, for instance, chloride of sodium. Setting aside the established custom in all commercial refineries of combining the elements in the mode we have adopted, our answer is, that refining itself proves that this formula points out the true composition of the salts. If the refining be well conducted, all the salts indicated by this formula will be obtained, and in almost exactly the same proportions.

Potashes Derived from the Grease of Wool.—Before terminating our account of salts, a few words may be added relative to the potashes derived from grease extracted from wool-washings. The potashes made from grease analysed by us were produced by M. Thery-Disière, who is at the head of an important manufactory at Verviers (Liége), and who was the first to use baths for the purpose of steeping wool, which was, formerly, always thrown into the river. Here is the composition of one of these potashes:—

Potash of Wool Grease.

	I.	II.	III.
Moisture	2·83	1·20	1·05
Insoluble matter	11·98	5·28	11 19
Chloride of potassium	5·88	6·12	7·04
Sulphate of potash	2·48	3·03	3·33
Carbonate of potash	71·52	79·01	72·25
Carbonate of soda	4·96	5·15	5·14
Non-estimated and loss	0·35	0·21	5·14
	100·00	100·00	100·00

Potashes extracted from wool grease are produced in several manufactories in France, and constitute an excellennt product, rich in carbonate of potash; but an important progress in this branch of manufacture yet remains to be realised, viz., the diminution, or even complete removal, of insoluble matter without recourse to refining.

Refined Potashes.

Refining the Salts.—The salts are broken into fragments the size of an egg, and lixiviated in water. The lixivium should mark from 20° to 25° on the Beaumé areometer; it is passed into cauldrons, where, by successive evaporations, crystallisations, and solutions, the separation of the salts is effected.

In the first set of cauldrons, the lixiviate is evaporated until it marks 40° on the Beaumé areometer; at this density, most of the sulphate of potash is precipitated. The liquid is left to settle, and decanted into crystallising pans, where the greater part of the chloride of potassium crystallises when quite cold.

The mother liquor is evaporated in the second set of cauldrons until it marks 45°, during which process it precipitates carbonate of soda. After settling, the lixiviate is again passed into the crystallising pans, where, on cooling, a new deposition of chloride of potassium takes place. The lixivium is again heated in the third set of cauldrons, and rendered sufficiently concentrated to mark either 50, 51, 52, or 53 areometric degrees. Carbonate of soda is still deposited; the liquid in the crystallising pans, when cool, still precipitates chloride of potassium, and, when evaporated to dryness, yields commercial refined potash, generally containing from 78 to 82 per cent of carbonate of potash. In order to obtain potashes refined to a still higher standard, these are dissolved at 80°, and the solution evaporated to 61 or 63 areometric degrees. Carbonate of soda is deposited, and the liquid obtained, when evaporated and calcined, yields potashes containing from 88 to 94 per cent of carbonate of potash.

Sulphate of Potash.—It has been shown that the greater part of the sulphate of potash contained in the salts was deposited during the first evaporation of the lixivium. This salt, polluted in the first instance by the impurities of the lixivium, contains, besides the alkaline carbonates, chloride of potassium. By means of rakes, the salt is taken up as it precipitates, placed to drain in vessels of perforated sheet iron, dissolved, and subjected to a fresh crystallisation. Commercial sulphate of potash is thus obtained.

Chloride of Potassium.—The chloride of potassium successively deposited during the different phases of evaporation of the lixivium is left to drain, and, when deprived of the liquid which moistens it, is saleable. After the second or third cooling, it is not, however, sufficiently pure to be introduced into trade, and must be collected and restored to the first set of cauldrons, there to be operated upon anew.

Carbonate of Soda.—The carbonate of soda produced by evaporation of the lixivium is purified after desiccation by means of successive solutions and crystallisations, repeated two or three times. The soda-salt thus obtained furnishes, after calcination, commercial white soda.

It is, of course, understood that these evaporations never produce salts in a state of complete purity, and that all products thus obtained are mingled more or less with other substances. Sulphate and chloride of potassium and carbonate of soda are manufactured by other processes than those we have described. On this subject a few words will be said when discussing more especially these different salts. We will at present confine ourselves to an examination of the composition of refined potash (carbonate of potash).

Method of Analysis and Composition of Refined Potash.

The analysis of refined potash is effected in a precisely similar manner to that of crude potash, except that it is more rapid, on account of the non-necessity of separating the insoluble substances, which occur in only the smallest proportions.

Twenty-five grms. of refined and pulverised potash are dissolved by decantation in a flask, and the obtained lixivium is diluted to the volume of 500 c.c. Decant 100 c.c. to obtain the standard, 100 c.c. to estimate the sulphate, 50 c.c. to determine the proportion of chlorine, and 10 c.c. to estimate the potassium, by means of bichloride of platinum. The moisture is estimated by heating the potash salt to a red heat in a platinum crucible. The analytical results given below may be considered as representative types of the different qualities of commercial refined potashes. As in the case of the beet-root salts, we give the names of the manufactories whence the specimens were obtained; and we here desire to thank those manufacturers who, while supplying all necessary information, have kindly authorised us to publish the composition of their products.

These results will show that commercial refined potashes contain from 69 to 93 per cent of carbonate of potash. It should be added that analyses Nos. 8 and 9 were performed upon carbonate of potassium from Stassfurt, according to the method of M. Leblanc.

Substances estimated.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.
Moisture and insoluble ...	3·05	0·80	0·61	0·68	2·00	0·38	5·66	0·21	0·42	15·56
Chloride of potassium	3·21	3·35	2·61	3·22	3·41	3·41	4·68	5·81	4·00	1·47
Sulphate of potash.....	2·31	1·48	0·80	2·00	4·62	1·41	2·00	3·45	2·10	0 11
Carbonate of potash.....	78·10	81·22	91·25	91·88	87·51	92·87	69 25	82·68	89·37	79·86
Carbonate of soda	13·33	13·15	4·73	2·22	2·46	1·93	18·41	7·85	4·11	3·00
Total.....	100·00	100·00	100·00	100·00	100 00	100·00	100·00	100·00	100·00	100·00
	Corbehem Distillery, near Douai; M. A. Lefebvre.			MM. Tillog-Delaune and Co., Courrierès (Pas de Calais).			X	MM. Vorster et Gruneberg, Cologne (Prussia).		Hydrated potash; maker unknown.

Chlorides of Potassium.

Commercial chlorides of potassium, or muriates of potash, contain sulphates, and frequently alkaline carbonates also; in certain cases a more or less considerable proportion of chloride of sodium is also found in them.

Method of Analysis.—Weigh 25 grammes of the muriate of potash to be tested, and dissolve them in a beaker; filter the solution to separate the insoluble matters, which usually occur only in very small proportion, and dilute it with water to the volume of ½ a litre.

Alkalimetric Standard.—This does not generally exceed 1° or 2°; for obtaining it, decant 100 c.c., corresponding to 5 grammes: ascertaining previously that the solution is alkaline, for it is possible that the muriate may not contain any alkaline carbonates.

Sulphuric Acid.—The sulphuric acid is estimated in 100 c.c. (5 grammes) by means of chloride of barium.

Chlorine.—The estimation of the chlorine is of great importance, and should be rigorously exact: take 10 c. c. of the filtered liquid tared to ½ a litre, and determine the amount of chlorine by means of a standard silver liquid. For greater exactness, it is a good plan to verify this estimation by directly weighing the chloride of silver precipitated in another experiment. Measure 10 c.c. (0·50 gr.) of the solution of muriate, and transfer them by means of a pipette into a beaker holding 500 c.c.; add a large quantity of boiling water, acidulate it with pure nitric acid, and precipitate the chlorine by a slight excess of nitrate of silver. The estimation previously made by means of the standard solution allows the quantity of nitrate of silver required to be calculated, so that the excess may not be great. The precipitate is well stirred with a glass rod, and the warm liquid settles so well that it is possible to wash the precipitate of chloride of silver by decantation with boiling water. When the washing water is not clouded on the addition of a drop of chlorhydric acid, it is thrown on a small filter, left to drain, and dried at 100°.

The desiccated precipitate is detached from the filter, which is calcined in a small tared porcelain capsule, and when the paper is burnt, the chloride of silver precipitate must be added and partially melted; it is then cooled, and the capsule weighed together with the chloride of silver; the weight of the precipitate is thus obtained by difference. The chloride of silver adheres closely to the capsule. In order to remove it, throw the whole into a glass, and place on it a piece of zinc, sulphuric acid, and water; the chloride of silver, partially reduced, will then separate from the capsule.

Potassium.—The estimation of potassium is effected in the same way as in the case of crude salts (see Chemical News, vol. xx., p. 73, *Am. Rept., Oct.*, '69, *p.* 207), by means of bichloride of platinum, working upon 10 c.c. (0·50 grms.)

Water.—The proportion of water is ascertained by heating, in a platinum crucible, a given weight of the muriate to be tested. A closed tube is still better, as it allows the loss from projections arising from the deflagrations of the salt to be more easily avoided.

Calculation of the Analysis.—Part of the estima-

ted potassium is combined with the sulphuric acid contained in the sulphate. If the excess of potassium is sufficient to combine with the whole of the chlorine, the latter is transformed into chloride of potassium; if not, the quantity of chlorine necessary to form chloride of potassium with the remaining potassium is calculated, and the excess of chlorine reckoned as chloride of sodium.

Composition of Commercial Muriates.

1. *Muriates containing Alkaline Carbonates.*

Substances estimated.	I.	II.	III.	IV.	V.	VI.	VII.	VIII.
Moisture	4·27	6·68	5.00	1·01	1·38	3·69	6.35	15 06
Insoluble matter	0·32	0·22	0·10	0·18	0·28	0·41	0·90	0·09
Sulphate of potash	12·31	9·45	12·31	5·50	4·01	14·18	11·81	11·62
Chloride of potassium	79·80	80·00	77·20	92·39	93·52	80·92	75·01	59·41
Carbonate of potash	1·00	3·25	3·10	0·92	0·61	0·49	3·28	13·82
Carbonate of soda	2·10	—	2·01		—	—	2·13	
Non-estimated and loss	0·20	0·40	0·28	—	0·20	0·31	0·52	—
Total	100·00	100·00	100·00	100·00	100·00	100·00	100·00	100·00
	MM. Vorster and Grüneberg, at Cologne.				M. P. Rohée, at Bordeaux.		M. A. Lefebvre, at Corbehem, near Douai.	

2. *Muriates containing Chloride of Sodium.*

Matters estimated.	I.	II.
Moisture	3·09	1·50
Insoluble substances	0·11	0·20
Sulphate of potash	0·81	4·61
Chloride of potassium	80·15	78·40
Chloride of sodium	15·01	14·09
Carbonate of soda	0·72	1·12
Non-estimated and loss	0 11	0·08
Total	100·00	100·00
	MM. Campion and Theroulde, at Granville.	

N. B. These sulphates proceed from a manufacture of iodine from kelp.

3. *Muriates containing neither Chloride of Sodium nor Carbonates.*

Substances estimated.	I.	II.	III.
Moisture	1·20	3·63	3·50
Insoluble matter	0·31	0·21	0·30
Sulphate of potash	6 90	11·86	4·55
Chloride of potassium	91·50	84·20	91·65
Non-estimated and loss	0·09	0·10	—
Total	100·00	100·00	100·00
		M. Paisant, jun., at Pont-l'Abbé (Finisterre).	

Chloride of potassium is obtained, as has been shown, from the beet-root salts; it is also extracted in abundant quantities from the ash of seaweed. The newly-discovered deposit at Stassfurt yields considerable quantities; and large kidney-shaped pieces of pure chloride of potassium have been found in abundance in the midst of that vast salt mass. We have repeatedly analysed this natural chloride of potassium (called by the Germans sylvin), and have never discovered more than 1-10th of foreign matter. Every sample which we examined contained from 80 to 99 per cent of chloride of potassium. This is a highly important fact; and it is well known that the influence of the exportation of the Stassfurt products is already making itself felt in the manufacture of potashes.

(To be continued).

PRELIMINARY NOTE ON

THE PRODUCTS OF THE DESTRUCTIVE DISTILLATION OF RESIN.

BY THOMAS ANDERSON, M.D., F.R.S.E., F.C.S.,
PROFESSOR OF CHEMISTRY IN THE UNIVERSITY OF GLASGOW.

I have been engaged for several years in the investigation of the distillation products of resin. The subject having proved one of great extent and complexity, it was not my intention to have made any part of it public until it was more complete than it is at the present moment, but the recent appearance of a similar investigation by Mr. Tichborne * has induced me to alter this intention and to publish my results, especially as some of them differ from those which he has obtained.

When common colophony is distilled, the first product is a small quantity of a volatile oil commonly known as "rosin spirit," consisting of some products of decomposition of the resin contaminated with a portion of the essential oil originally existing in the turpentine. When this is separated, an oil is obtained which becomes more and more viscid as the distillation proceeds, and shows a gradually increasing blue fluorescence as the temperature rises, and at last a small quantity of charcoal is left in the still. When this crude resin oil is rectified, the first product is a "rosin spirit," larger in quantity and somewhat different in smell from that obtained in the first distillation. This is followed by a mixture of thick oils of high boiling point, and the last product, if kept separate, acquires, on cooling, the consistency of soft butter, or rather of oil and butter. When this is exposed to a freezing mixture and expressed, a solid crystalline substance is left on the cloth, which, when purified, proves to be the metanaphthaline or retisterene, of Pelletier and Walter.

My investigations hitherto have been mainly confined to the spirit obtained in rectifying the crude resin oil. When this is submitted to a systematic fractionated distillation, it splits up into a variety of oils, and after seven or eight rectifications, fractions are obtained at all temperatures, from 70°, C. up to 400°, the latter being of course portions of the less volatile oils which passed over at the first rectification.

The fractions boiling between 125° and 150° deposit a crystalline substance, which is obviously an oxidation

* Chemical News, vol. xx., p. 38 (*Am. Repr., Sept.*, '69, p. 147).

product, and increases in quantity when the oil is preserved in partially filled bottles. This substance is Mr. Tichborne's colophonine. It is soluble in water, ether, and alcohol, and is deposited from the hot solutions in long needle-shaped crystals, which fuse at 106° and sublime easily at a higher temperature. Their smell is aromatic, and they have a warm and somewhat pungent taste. They were purified by expression, exposure to the air until the oil attached to them had evaporated, and then subliming repeatedly. The results of combustion were as follows:—

(I.) 0·425 gramme gave 1·004 CO_2 and 0·424 H_2O.
(II.) 0·2225 gramme gave 0·526 CO_2 and 0·225 H_2O.

	I.	II.	Calculation.		
Carbon	64·43	64·47	64·61	C_7	84
Hydrogen	11·09	11·24	10·77	H_{14}	14
Oxygen			24·62	O_2	32
			100·00		130

This corresponds completely with the empirical formula $C_7H_{14}O_2$ which bears a simple relation to terebic acid, $C_7H_{10}O_4$. I have endeavoured, but as yet without success, to convert this substance into terebic acid by means of oxidising agents. By strong nitric acid it is converted into oxalic acid, with more dilute acid a resin is produced, but I have not obtained it in sufficient quantity to admit of any process of purification being applied to it. Not having analysed the crystals of this substance deposited from water, I failed to detect Mr. Tichborne's hydrate of colophonine, but the composition he gives for it is not altogether inconsistent with my formula, for a hydrate $C_7H_{14}O_2 + H_2O$ would give—

Carbon	56·75
Hydrogen	10·81

The oils contained in resin spirit are very complex, and consist of a mixture of hydrocarbons, the investigation of which is still quite incomplete. The most volatile fraction, which was very small and boiled between 70° and 80°, contained a volatile acid, apparently acetic acid, which gave abundant white fumes with ammonia. After separation of this acid by washing with water and drying, the oil gave—

Carbon	84·62
Hydrogen	13·71

Though the oil obviously contains oxygen, these numbers approximate to the composition of an olefiant, and its vapour density was 3·257, agreeing sufficiently with 3·386, which is the theoretical number for heptylene. The oil is probably a mixture of this substance with some oxygenated product, but the quantity at my disposal did not permit of any process of separation being employed.

At the temperature of 107° a larger quantity of oil was obtained, also containing oxygen. It gave, on combustion—

	I.	II.
Carbon	85·90	86·44
Hydrogen	12·75	12·97
	98·65	99·41

in which the carbon agrees with that of an olefiant, although the hydrogen is deficient. As far as analysis is concerned, the oil appears to be homogeneous, for, on rectifying it and separating the first few drops and the last few drops of the distillate, they were found, on combustion, to give identical results. The action of reagents, however, leads to an opposite conclusion. When digested for some time at 220° with strong hydriodic acid, it is converted into a black oil heavier than water. This, after being washed with potash and dried, yielded on distillation two oils, one boiling at about 177°, which contains iodine, is partially decomposed by distillation, and for which no formula could be obtained, and a non-iodized oil, very viscous, with green fluorescence, and boiling at 290°. On combustion it gave the following results:—

	Experiment.	Calculation.		
Carbon	87·94	88·24	C_{10}	120
Hydrogen	12·19	17·76	H_{16}	16
	100·0	00·00		136

It is therefore a terpene apparently corresponding with the colophene or metaterpene of Berthelot.

Of the less volatile oils, I have as yet examined only one boiling at 157°, and another boiling at a higher temperature. The former is an oxygenated oil, with a specific gravity of 0·853. The results of its analyses in the first instance approximated to those of terpinol, with which, however, it is only isomeric and not identical. But some results afterwards obtained lead me to suspect that it may be a product of hydration of a terpene existing in the crude oil. When treated with sulphuric acid, heat is evolved, and the oil, after being separated from the acid and purified by distillation, has exactly the smell and composition of terebene. The products at higher boiling points appear to be terpenes, but they give no solid hydrochlorates, and their separation presents difficulties which I have not hitherto been able to overcome.

I trust I may be able at some future period to throw further light on the constitution of these substances; my investigation of which must be considered for the present as entirely preliminary.

ON THE

ESTIMATION OF THE SO-CALLED PRECIPITATED PHOSPHATES IN MANURES,

AND THE

ESTIMATION OF SOLUBLE PHOSPHATES GENERALLY.

BY FRANCIS SUTTON, F.C.S., NORWICH.

The difficulty presented by this subject has lately been discussed in this journal from two points of view, namely, that of the manure manufacturer and the professional analyst.

Any one who knows anything of the matter must certainly feel, with the manufacturer, that it is a real grievance to have expended time and money in producing soluble phosphate which, owing to this reducing action, is valued at only about one-third the price it ought to sell for.

Again, on the other hand, the analyst is asked to say how much phosphate of lime soluble in water is present in a particular sample of manure, and his duty is plainly to treat such a sample with water only, and state the percentage of phosphate therein.

The manufacturer says, I believe the recently-reduced phosphate is quite as effectual in action as the soluble phosphate, because I am told by good authorities that, so soon as soluble phosphates come in contact with the soil, they are rendered insoluble, and, therefore, why

should not my recently-precipitated phosphates be just as valuable as the soluble phosphates? The only reply that can be made to this is that the analyst, unless he can find a reliable process for estimating recently-reduced phosphates, must consider and value them solely as insoluble phosphates. It has been proposed to use citric acid, oxalic acid, or oxalate of ammonia for the purpose of rendering these phosphates soluble, in order that they may be estimated and valued at a higher price than ordinary insoluble phosphates.

If it can be shown that any of these reagents will affect such a material as Cambridge coprolite, and render it soluble in water, it is manifest that such aids cannot be depended upon for the purpose required.

This seems to have been pretty well settled by the experiments of Mr. Hughes; but the results obtained by him have been cavilled at by one of your correspondents ("Fair Play") as being conducted in an improper way. As I am situated in the heart of a large manure-consuming district, and continually estimating phosphates, it has occurred to me to extend these experiments somewhat further, and I think the result will show that no real dependence can possibly be placed upon any of the hitherto-suggested plans for determining these reduced phosphates.

The experiments were made upon two substances, namely, a mineral superphosphate which originally contained about 23 per cent of soluble phosphates (calculated as bone-earth), but which, at the time of the first experiment, yielded only between 17 and 18 per cent, together with about 10 per cent of insoluble; the other substance was raw Cambridge coprolite, containing about 56 per cent of insoluble phosphate of lime. All the determinations were made by the acetate of uranium process, in the presence of a slight excess of free acetic acid.

1. One grm. superphosphate, treated first with cold and afterwards with hot water, yielded 17·7 per cent soluble phosphate.

2. One grm. finely-ground coprolite, treated precisely in same manner (as might be expected), gave no soluble phosphate.

3. Residue of No. 1, boiled with 100 c.c. water and 4 c.c. strong acetic acid, yielded 2·3 per cent soluble phosphate.

4. One grm. coprolite, with same proportions of water and acetic acid, gave 4·8 per cent soluble.

5. One grm. of the superphosphate, heated with equal parts of acetic acid and water, gave 19·5 per cent soluble.

6. One grm. coprolite, treated in the same manner, gave 9·9 per cent soluble.

7. One grm. coprolite, heated with 1 grm. citric acid and 100 c.c. water, gave 10·4 per cent soluble.

8. One grm. coprolite, with same quantities of tartaric acid and water, gave 10·8 per cent soluble.

9. One grm. of same superphosphate, digested in the cold with ½ litre of water for twelve hours, gave 14·8 per cent soluble.

10. One grm. of the same superphosphate, but some five or six weeks older, was put into a vessel with ½ a litre of water, and charged with 10 volumes of carbonic acid for five hours; the yield was 13·8 per cent soluble.

11. One grm. coprolite was treated precisely in same manner, and gave slight traces only of soluble phosphate.

12. 2·5 grms. same superphosphate, digested in the cold with 2·5 grms. oxalate of ammonia in ½ litre of water for twelve hours, gave 16·0 per cent soluble.

13. 2·5 grms. coprolite, digested in the cold with same weight of oxalate in ½ litre of water for twelve hours, gave no soluble phosphate.

14. 2·5 grms. superphosphate and 2·5 grms. oxalate of ammonia were mixed with ½ litre water, and heated on the water bath one hour; the yield was 17·1 per cent.

15. One grm. superphosphate, with 1 grm. oxalate, were mixed with 50 c.c. water, and digested half an hour on water-bath; the yield was 19·4 per cent soluble.

16. Same weights of both were mixed with 50 c.c. water, and digested in the cold twelve hours; the yield was 17·6 per cent soluble.

17. One grm. superphosphate, with 1 grm. oxalate, were mixed with 50 c.c. water, and boiled ten minutes; the yield was 22·6 per cent soluble.

18. One grm. coprolite, boiled for same time in 50 c.c. water and 1 grm. oxalate, gave 10·8 per cent soluble.

The results of these experiments are, in some respects, anomalous, but a little consideration will probably throw some light on the matter.

The superphosphate here examined contained considerable quantities both of iron and alumina; and it seems that it is only such phosphates that are, to any considerable extent, liable to this reduction. The true explanation of their action in this respect I cannot pretend to give, nor have I heard of any being given by others; it is, however, well known that raw phosphates containing these substances make very soft and pasty manures, which, before they can be rendered marketable, must be dried by the addition of some absorbing substance which, as it removes the constitutional water from the iron or alumina phosphates, converts them into some basic form which is not soluble in plain water. If it be the case that iron or alumina, or both, are at the bottom of this matter, this explains the slight effect which acetic acid has upon the residue of this particular superphosphate after exhaustion with water (see experiments 3 and 5); while the plain coprolite, containing only slight traces of iron or alumina, yields double the percentage of soluble phosphate under the same treatment in experiment 4, and about five times as much in experiment 6.

With regard to the effect which oxalate of ammonia has upon reduced phosphates, it appears that no very great increase of soluble phosphate is obtained by dilute solutions in the cold, or upon coprolite; but when a boiling heat is used, and the solution concentrated, a considerable yield is obtained in the case of the reduced phosphates, and as much as 10·8 per cent from the coprolite.

It does, therefore, appear that, where a superphosphate contains the so-called reduced phosphates, their amount may pretty nearly be found by the use of oxalate of ammonia in a boiling solution. But it is quite another question whether the phosphates so recovered are as valuable as if they were soluble in water; at any rate, carbonic acid, under considerable pressure, has no more effect upon them than it has upon raw coprolite. The thing which does affect them, namely, oxalic acid, acts upon hard raw coprolite still more; and this does not favour the supposition that they are as valuable as if they had never been reduced.

Again, suppose a manufacturer chooses to mix off some tolerably pure form of insoluble phosphate with a superphosphate liable to reduction; the analyst who used the oxalate process for estimation would, probably, report several per cents of soluble phosphate in the manure which had never been in the soluble state at all,

and the farmer would be asked to pay about three times as much for such phosphates as he might have bought them for in the form of coprolite.

Under such circumstances as these, it, therefore, seems that the duty of the analyst is plainly to state the absolute truth—namely, that such a sample of manure contains so much phosphate of lime soluble in water—and there leave it. I repeat that this is a hardship to the maker, in many cases; but I am not certain that it is necessary for him to incur this risk.

I would now say a word or two relative to the method of estimating soluble phosphates; the stigma which has been brought upon professional chemists in general by the fact that some well-known professional men invariably give high results, while others, also, invariably give low ones, is considerable, and ought, if possible, to be removed.

This discrepancy may, in most cases, be accounted for by the process adopted in determining the phosphates; and, in order to remedy this evil, I would recommend the universal use of one process only, granting that a good and reliable process can be found.

All chemists are aware of the good effect which has resulted from the adoption of this system in silver assaying by the wet method and others of like nature; and I see no reason why it should not be adopted in the matter of soluble phosphates. There may, of course, be a difference of opinion as to what process shall be adopted, but I know of none so reliable for manures of all descriptions (for soluble phosphates), as the uranium process by weight (fully described by me in this journal of February 4th and 18th, 1860). A very large number of analyses made in my laboratory since that time, and tested by every conceivable comparison, have brought the conviction that no other process is, at the same time, so short and so exact, and is quite available, without modification, in the presence of iron or alumina phosphates usually found in some samples of manure. An analysis can be begun and completed within three hours; and, of course, a series may be carried on at one and the same time, if a sufficient number of vessels are at hand. The objection against the process, on the ground of expense, amounts to nothing, since the whole of the uranium can be recovered again for repeated use.

DETECTION OF POTASH AND SODA BY BLOWPIPE VESICULATION.

The following letter and list of experiments has been forwarded by Capt. W. A. Ross, R.A., to Professor Theodore von Richter, Head of the Royal College of Freiburg, and also to us for publication in the Chemical News:—

Simla, India, June 17th, 1869.

Dear Sir,—In accordance with the request contained in your letter of the 1st of January, 1868, to my address at Woolwich, to be informed of the result of my further labours in the matter of blowpipe vesiculation discovered by me, I have the pleasure now to communicate the following:—On arriving here in April, the weather being very warm and dry, and an aneroid barometer compensated for heat standing only at 22·80°, I made some borax vesicles of KOHO and CaCl, and other of the most deliquescent salts I had, none of which, to my surprise, either deliquesced or showed the least sign of crystallisation. They remained unchanged until the 8th of June, when very heavy rain fell the whole day and night. Next morning the potash vesicle had partly deliquesced, and the rest were covered with crystals. From this fact I ascertained that the vesicular crystallisations of borax discovered by me are all superposed, or formed from the hygrometric moisture of the air, and not pyrogenous, or formed from the hot borax on cooling, like those mentioned by Berzelius (pp. 64, 190, 214, &c., of the American Translation, Boston, 1845), Rose of Berlin, and other writers. As it appeared to me that the moist atmosphere could only act with uniformity on uniformly composed substances presented to it for crystallisation, I strove to attain something like uniformity by measuring 50 milligrammes of borax for each bead, taking up as near as possible an equal quantity in each case of the substance to be examined. I found this a troublesome process, and hit upon a far easier and equally exact method—by measuring the bead after it had cooled, by slipping over it a glass tube of the diameter of 5° on the lead measure, filing a shoulder on the top of the platinum wire-holder to allow the tube to stand upright over the wire, and then seeing with the magnifying glass how far the sides of the bead (placed with the wire next the eye) were from touching the sides of the tube. I reflected, however, that borax, being a compound salt, could scarcely be expected to give uniform results chemically, either as regards crystallisation or any other operation, and connecting the fact in my mind that alkalies and alkaline earths always give a cloudiness to vesicles of borax in moist weather with the other facts—(1) that the "boron diamond" can only be attacked by the fused hydrates of the alkalies; and (2) that alkaline borates are freely soluble, while those of the other bases are either insoluble or very sparingly so—I determined to operate if possible on pure boracic acid. I was much pleased to find that substance easily blown into vesicles (having expected the contrary), as it is very viscid when the HO and air bubbles are expelled from it, and I found that its vesicles, being thinner than those of borax, invariably possessed a most brilliant iridescence. But the most useful feature to me was the fact of their clouding over a few seconds after formation, with a delicate blue white film upon which the iridescent colours, gleaming beneath, bestowed a beautiful opaline or mother-of-pearl lustre which I have called "opalescence." I immediately saw that as the borax vesicle is clear and the boracic acid one opaline, a valuable and sure means of detecting the presence of soda, at least in the proportion in which it enters into the composition of borax, is thus afforded, for that amount of soda in the subject of analysis would of course combine with the BO_3 forming a boracic acid (or clear) vesicle. I will not fatigue you with details of the experiments I made, 48 of which I have the pleasure to enclose. You will be able to draw just conclusions from them or others repeated far better than I can possibly do, but I may venture to state that my object hitherto has been almost exclusively confined to a means of isolating, by this method, potash from soda, the blowpipe flame and oxide of nickel tests being, as you are aware, almost worthless, and that, by the wet analyses, a long, tedious, and difficult operation. Without troubling you with details (which will be found in the experiments) I ventured to conclude—

1st. That soda and fluor spar (CaF) interfere with the opalescence of BO_3 vesicles.

2nd. That potash does not interfere with it.

3rd. That chlorine increases it both as to quickness of appearance and intensity.

4th. That CO_2 causes it to appear after a time weakly, even in the presence of soda.

I regret I have no pure or caustic soda to operate

with, nor can I obtain it nearer than Calcutta. Experiments 17 and 20 show that 10 to 13 c.c. of potash Alaunstein can be detected by this method in presence of 53Fl and 32 soda (in kryolite), and, on the other hand, experiment 48 shows that, without soda as a constituent, potash alone fails to neutralize the effect of CaF in preventing the opalescence of vesicles of boracic acid.

I have, as you will see, attempted scarcely anything but the two alkalies—the acids and metals, &c., remaining for future examination. It was easy enough to distinguish by this method between potash and soda in pure salts, but I found it more difficult when applied to traces of those alkalies in silicates; still, I discovered, as you will see, traces of potash by this means in the soda minerals, "albite, analcine, and labradorite," supplied me from Freiberg, while kryolite showed not a trace, and when artificially supplied with KO from Alaunstein, immediately showed a strong trace of that alkali.

Besides being (I hope) found to be most useful in detecting soda and potash in minerals, and of making BO_3 and CaF betray each other, these boracic acid vesicles form the most delicate hygrometers possible, clouding over with a rapidity proportional to the amount of moisture contained in the atmosphere. If the air is so very dry that even boracic acid vesicles take some time to opalesce, the addition of chlorine will make them still more sensitive, and if the air is very moist, that of CaF far less so, until absolute insensibility (or transparency) is attained. I regret that the departure to-day of the mail prevents my saying more at present on this interesting subject. Pray let me know what result your experiments on the subject give, and believe me, yours with great respect,

W. A. Ross.

EXPERIMENTS IN VESICULATION WITH BORACIC ACID, June 13, 1869.

(Bar. 22·70; Ther. 82; Air, very dry.)

1. BO_3+KOHO.	Opalesced in four minutes.
2. BO_3+$NaOCO_2$.	Remained quite clear for hours.
3. BO_3+$KOCO_2$.	Opalesced in fifteen minutes.
4*a*. BO_3+NaCl.—At first I took a large quantity of BO_3, and could not take enough Na from the NaCl to satisfy it, as the bead dropped off.	The BO_3 therefore apparently seized upon a part of the Cl (which came off in thick fumes) and the vesicle clouded over the moment it was taken from the flame.
4*b*. Tried NaCl again, in large quantity, with very little BO_3.	Fumes of Cl, when stopped vesicle made; remained quite clear ever since up to to-day (June 17).
5. BO_3 + MoS.—The native sulphide.	Clouded (not opalesced) in quarter of an hour; afterwards crystals formed exactly like leopards' spots.
6. Tried 4*a* and 1 near the flame of spirit lamp.	Opalescence vanished immediately, leaving a clear dry vesicle exactly like the volatilisation of the sublimate of arsenic from charcoal before the blowpipe.
7. Alaunstein.	Opalesced in fifteen minutes.
8. Kryolite.	Remained quite clear to date; vesicle much less fragile and iridescent than those of BO_3, and bead more fluid.
9. Adular.	Opalesced slightly in twenty minutes.
10. Albite.	Faint opalescence after quarter of an hour.
11. SiO_2 powdered.	The SiO_2 remained undissolved; the BO_3 opalesced strongly after quarter of an hour.
12. Vesiculated KOHO in borax; made a hole with pin at top, and breathed upon it.	Deliquesced rapidly and translucently on the edges of the hole, without having clouded over or opalesced in any way; crystals afterwards formed on edges of the hole.
13. Breathed upon 1 and 4*a* when freshly re-made.	Both rapidly opalesced, but when heated very gently near spirit lamp, frothed instead of vanishing.
14. Mixed 11 with a little kryolite.	Opalesced slightly.
15. Mixed ditto with NaCl, driving off the Cl well, as I did not think it had Na enough.	Remained quite clear to date (17th).
16. Analcim.	Very difficult to make; opalesced faintly in quarter of an hour.
17. Ditto, with CaF.	Remained quite clear to date.
18. Labradorite.	Opalesced pretty strongly in twenty minutes.
19. Ditto, with CaF.	Remained quite clear to date.
20. Mixed 7 and 8.	Opalesced pretty strongly.
21. " 7 with CaF.	Remained quite clear all night.
22. " 9 " "	" " "
23. " 10 " "	" " "
24. Re-made 12 and added BO_3.	Remained clear for twenty-five minutes.
25. Re-made 1 and added $NaOCO_2$.	Opalesced faintly in quarter of an hour.
26. Re-made 21, 22, and 23, and added KOHO to each in large quantity.	Remained quite clear to date.
27. Pure boracic acid.	Opalesced round platinum wire in thirty seconds.
28. Re-made 4*a* and 1 fresh.	Opalesced in a few seconds, 4*a* quickest.
29. Re-made 20 and added $NaOCO_2$.	Remained quite clear to date.
30. Added BO_3 to 24.	Remained clear for twenty minutes.
31. Added $NaOCO_2$ to 25.	Opalesced very faintly in quarter of an hour at one end only.
32. Added more $NaOCO_2$ tto.	Remained quite clear to date.
33. Added much BO_3 to 3.	Bead very fluid; opalesced in quarter of an hour.
34. Re-made 27.	Opalesced slightly in one minute; all over in twenty minutes.

35. Added NaCl to much BO_3. Began to opalesce in thirty seconds: completely opalesced in two and a half minutes.
36. Added more NaCl to ditto. Remained quite clear.
37. BO_3+CaCl to saturation. No Cl disengaged; vesicle clouded mechanically with Ca.
38. BO_3+very little CaCl. Opalesced in one minute, but did not increase.
39. Pure boracic acid. Opalesced slightly in half a minute; all over in five minutes.
40. Re-wetted 37 with geblase. Bead opaque; vesicle opalesced in ten minutes.
41. BO_3 with slight trace CaF. Opalesced in quarter of an hour.
42. The same with double CaF. Remainder quite clear to date.
43. BO_3 with trace CaF. Opalesced in quarter of an hour.
44. Pure boracic acid. Opalesced slightly in half a minute; all over in three minutes.
45. $NaOCO_2$ (sub-carbonate). Opalesced slightly in ten minutes.
46. " (double quantity). Opalesced considerably in quarter of an hour.
47. " (more $NaCO_3$). Remained clear to date.
48. Added KOHO to 42. " " "

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

EXETER MEETING, AUGUST 18, 1869.

INAUGURAL ADDRESS OF THE PRESIDENT,

GEORGE GABRIEL STOKES, M.A., SEC. R.S.,
D.C.L., OXON; LL.D., DUBLIN;
FELLOW OF PEMBROKE COLLEGE; AND LUCASIAN PROFESSOR OF MATHEMATICS IN THE UNIVERSITY OF CAMBRIDGE.

MY LORDS, LADIES, AND GENTLEMEN,—

As this is the first time that the British Association for the Advancement of Science has met in the city of Exeter, and it is probable that many now present have never attended a former meeting, I hope the older members of the Association will bear with me if I say a few words in explanation of the objects for which the Association was instituted. In the first place, then, it aims at fulfilling an office which is quite distinct from that of the various scientific societies which are established in different parts of the country. These, for the most part, have for their leading object to make the voluntary labors of isolated workers in science available to the scientific world generally, by receiving, discussing, and publishing the results which they may have obtained. The British Association, on the other hand, aims at giving *a more systematic direction* to scientific inquiry, and that in various ways.

Objects of the Association.—Scientific Reports.

In a rapidly progressing branch of science it is by no means easy to become acquainted with its actual state. The workers in it are scattered throughout the civilized world, and their results are published in a variety of Transactions and scientific periodicals, mixed with other scientific matter. To make oneself, without assistance, well acquainted with what has been done, it is requisite to have access to an extensive library, to be able to read with facility several modern languages, and to have leisure to hunt through the tables of contents, or at least the indices, of a number of serial works. Without such knowledge, there is always the risk that a scientific man may spend his strength in doing over again what has been done already; whereas, with better direction, the same expenditure of time and labour might have resulted in some substantial addition to our knowledge. With a view to meet this difficulty, the British Association has requested individuals who were more specially conversant with particular departments of science, to draw up reports on the present state of our knowledge in, or on the recent progress of, special branches; and the influence of the Association as a public body has been found sufficient to induce a number of scientific men to undertake the great labour of preparing such reports.

By thus ascertaining thoroughly what we already had, what we still wanted was made more clear; and, indeed, it was one special object of the reports I have mentioned to point out what were the more prominent desiderata in the various subjects to which they related. The Association was thus the better enabled to fulfil another of its functions, that of organising means for the prosecution of researches which require co-operation. When the want is within the compass of what can be accomplished by individuals, the demand may be left to create the supply; but it often happens that a research can hardly be carried out without co-operation. It may, for instance, require a combination of the most profound theoretical knowledge with the greatest experimental skill, or an extensive knowledge of very dissimilar branches of science; or, again, the work to be done, though all of one kind, may be of such an extent as to be beyond the power of any one man. In such cases, the limited power of the individual can only be supplemented by the principle of co-operation; and, accordingly, it becomes an important part of the business of the Association to organise committees for the prosecution of special researches. The researches thus undertaken, at the request of the Association, are published at length, along with the reports on the progress of science, in the first part of the annual volume.

Money Grants.

In close connection with the last, must be mentioned another mode in which the Association contributes to the progress of science. Many researches require not only time and thought, but pecuniary outlay; and it would seem hard that scientific men who give their time and labour gratuitously to carrying out such researches should be further obliged to incur an expenditure which they often can ill afford. The Association accordingly makes grants of money to individuals or committees for defraying the expenses of such researches. It appears, from the report which has just been published, that, reckoning up to the year 1867 inclusive, the sum of £29,312 4s. 1d. has been voted by the Association for various scientific objects. Deducting from this the sum of £23 16s., for the balances of grants not wholly expended, which were returned to the Association, we may say that £29,288 8s. 1d. has been expended in the manner indicated. When we remember that these grants were mostly of small amount, and do not include personal expenses, and

that very many of the researches undertaken at the request of the Association do not involve money grants at all, we may form some idea of the amount of scientific activity which has been evoked under the auspices of the Association.

Recent Progress of Science.

In the address with which the business of the meeting is opened, it is usual for your President to give some account of the most recent progress of science. The task is by no means an easy one. Few, indeed, are familiar with science in all its branches; and even to one who was, the selection of topics, and the mode of treating them, would still present difficulties. I shall not attempt to give an account of the recent progress of science in general, but shall select, from those branches with which I am more familiar, some examples of recent progress, which may, I hope, prove to be of pretty general interest. And even in this, I feel that I shall have to crave your indulgence; for it is hard to be intelligible to some without being wearisome to others.

Astronomy.

Among the various branches of physical science, astronomy occupies, in many respects, a foremost rank. The movements of the heavenly bodies must have occupied the attention and excited the interest of mankind from the earliest ages, and accordingly the first rudiments of the science are lost in the depths of antiquity. The grandeur of the subjects of contemplation which it presents to us have won for it especial favour, and its importance in relation to navigation has caused it to be supported by national resources. Newton's great discovery of universal gravitation raised it from the rank of a science of observation to that of one admitting of the most exact mathematical deduction; and the investigation of the consequences of this law, and the explanation thereby of the lunar and planetary disturbances, have afforded a field for the exercise of the highest mathematical powers on the part of Newton and his successors. Gradually the apparent anomalies, as they might have been deemed, in the motions of the heavenly bodies, were shown to be necessary consequences of the one fundamental law; and at last, as the result of calculations of enormous labour, tables were constructed enabling the places of those bodies at any given time to be determined years beforehand with astonishing precision. A still more striking step was taken. When it had been shown, by careful calculation, that the apparent motion of the remotest of the planets then known to belong to our system could not be wholly explained on the theory of gravitation, by taking account of the disturbing powers of the other known planets, Adams, in our own country, and Le Verrier, in France, boldly reversed the problem, and, instead of determining the disturbing effect of a known planet, set themselves to inquire what must be the mass and orbit of an unknown planet which shall be capable of producing, by its disturbing force, the unexplained deviations in the position of Uranus from its calculated place. The result of this inquiry is too well known to require notice.

After these brilliant achievements, some may, perhaps, have been tempted to imagine that the field of astronomical research must have been well-nigh exhausted. Small perturbations, hitherto overlooked, might be determined, and astronomical tables thereby rendered still more exact. New asteroids might be discovered by the telescope. More accurate values of the constants with which we have to deal might be obtained. But no essential novelty of principle was to be looked for in the department of astronomy; for such we must go to younger and less mature branches of science.

Researches which have been carried on within the last few years, even the progress which has been made within the last twelve months, shows how short-sighted such an anticipation would have been; what an unexpected flood of light may sometimes be thrown over one science by its union with another; how conducive, accordingly, to the advancement of science may be an association like the present, in which not only are the workers at special sciences brought together in the sectional meetings, but in the general meetings of the Association, and in the social intercourse, which, though of an informal character, is no unimportant part of our proceedings, the cultivators of different branches of science are brought together, and have an opportunity of enlarging their minds by contact with the minds of others, who have been used to trains of thought of a very different character from their own.

The Velocity of Light.

The science of astronomy is indebted to that of optics for the principles which regulate the construction of those optical instruments which are so essential to the astronomer. It repaid its debt by furnishing to optics a result which it is important we should keep in view in considering the nature of light. It is to astronomy that we are indebted for the first proof we obtained of the finite velocity of light, and for the first numerical determination of that enormous velocity. Astronomy, again, led, forty-four years later, to a second determination of that velocity in the remarkable phenomenon of aberration discovered by Bradley, a phenomenon presenting special points of interest in relation to the nature of light, and which has given rise to some discussion, extending even to the present day, so that the Astronomer Royal has not deemed it unworthy of investigation, laborious as he foresees the trial is likely to prove, to determine the constant of aberration by means of a telescope having its tube filled with water.

If, in respect of these phenomena, optics received much aid from astronomy, the latter science has been indebted to the former for information which could not otherwise have been obtained. The motions and the masses of the heavenly bodies are revealed to us more or less fully by astronomical observations; but we could not thus become acquainted with the chemical nature of these distant objects. Yet, by the application of the spectroscope to the scrutiny of the heavenly bodies, evidence has been obtained of the existence therein of various elements known to us by the chemical examination of the materials of which our own earth is composed; and not only so, but light is thrown on the state in which matter is there existing, which, in the case of nebulæ especially, led to the formation of new ideas respecting their constitution, and the rectification of astronomical speculations previously entertained. I shall not, however, dwell further on this part of the subject, which is now of some years' standing, and has been mentioned by more than one of your former presidents, but will pass on to newer researches in the same direction.

Proper Motion of the Fixed Stars.

We are accustomed to apply to the stars the epithet *fixed*. Night after night they are seen to have the

[English Edition, Vol. XX., No. 508, pages 85, 86.]

same relative arrangement; and when their places are determined by careful measurement, and certain small corrections due to known causes are applied to the immediate results of observation, they are found to have the same relative distances. But when instead of days the observations extend over months or years, it is found that the fixity is not quite absolute. Defining as fixity invariability of position as estimated with reference to the stars as a whole, and comparing the position of any individual star with those of the stars in its neighbourhood, we find that some of the stars exhibit "proper motions," show, that is, a progressive change of angular position as seen from the earth, or rather as they would be seen from the sun, which we may take for the mean annual place of the earth. This indicates linear motion in a direction transverse to the line joining the sun with the star. But since our sun is merely a star, a line drawn from the star exhibiting proper motion to our sun is, as regards the former, merely a line drawn to a star taken at random, and therefore there is no reason why the star's motion should be, except accidentally, in a direction perpendicular to the line joining the star with our sun. We must conclude that the stars, including our own sun, or some of them at least, are moving in various directions in space, and that it is merely the transversal component of the whole motion, or rather of the motion relatively to our sun, that is revealed to us by a change in the star's apparent place.

How then shall we determine whether any particular star is approaching to or receding from our sun? It is clear that astronomy alone is powerless to aid us here, since such a motion would be unaccompanied by change of angular position. Here the science of optics comes to our aid in a remarkable manner.

The pitch of a musical note depends, as we know, on the number of vibrations which reach the ear in a given time, such as a second. Suppose, now, that a body, such as a bell, which is vibrating a given number of times per second, is at the same time moving from the observer, the air being calm. Since the successive pulses of sound travel all with the velocity of sound, but diverge from different centres, namely, the successive points in the bell's path at which the bell was when those pulses were first excited, it is evident that the sound-waves will be somewhat more spread out on the side from which the bell is moving, and more crowded together on the side towards which it is moving, than if the bell had been at rest. Consequently the number of vibrations per second which reach the ear of an observer situated in the former of these directions will be somewhat smaller, and the number which reach an observer situated in the opposite direction somewhat greater, than if the bell had been at rest. Hence to the former the pitch will be somewhat lower, and to the latter somewhat higher, than the natural pitch of the bell. And the same thing will happen if the observer be in motion instead of the bell, or if both be in motion; in fact, the effect depends only on the *relative* motion of the observer and the bell in the direction of a line joining the two—in other words, on the velocity of recession or approach of the observer and the bell. The effect may be perceived in standing by a railway when a train in which the steam-whistle is sounding passes by at full speed, or better still, if the observer be seated in a train which is simultaneously moving in the opposite direction.

The present state of optical science is such as to furnish us with evidence of a force which is perfectly overwhelming, that light consists of a tremor or vibratory movement propagated in an elastic medium filling the planetary and stellar spaces, a medium which thus fulfils for light an office similar to that of air for sound. In this theory, to difference of periodic time corresponds difference of refrangibility. Suppose that we were in possession of a source of light capable, like the bell in the analogous case of sound, of exciting in the æther supposed at rest vibrations of a definite period, corresponding, therefore, to light of a definite refrangibility. Then, just as in the case of sound, if the source of light and the observer were receding from or approaching to each other with a velocity which was not insensibly small compared with the velocity of light, an appreciable lowering or elevation of refrangibility would be produced, which would be capable of detection by means of a spectroscope of high dispersive power.

Alteration of the Refrangibility of a Ray of Light.

The velocity of light is so enormous, about 185,000 miles per second, that it can readily be imagined that any motion which we can experimentally produce in a source of light is at rest in comparison. But the earth in its orbit round the sun moves at the rate of about 18 miles per second; and in the motions of stars approaching to or receding from our sun we might expect to meet with velocities comparable with this. The orbital velocity of the earth is, it is true, only about the one ten-thousandth part of the velocity of light. Still the effect of such a velocity on the refrangibility of light, which admits of being easily calculated, proves not to be so insensibly small as to elude all chance of detection, provided only the observations are conducted with extreme delicacy.

But how shall we find in such distant objects as the stars an analogue of the bell which we have assumed in the illustration drawn from sound? What evidence can we ever obtain, even if an examination of their light should present us with rays of definite refrangibility, of the existence in those remote bodies of ponderable matter vibrating in known periods not identical with those corresponding to the refrangibilities of the definite rays which we observe? The answer to this question will involve a reference, which I will endeavor to make as brief as I can, to the splendid researches of Professor Kirchhoff. The exact coincidence of certain dark lines in the solar spectrum with bright lines in certain artificial sources of light had previously been in one or two instances observed; but it is to Kirchhoff we owe the inference from an extension of Prevost's theory of exchanges, that a glowing medium which emits bright light of any particular refrangibility *necessarily* (at that temperature at least) acts as an absorbing medium, extinguishing light of the same refrangibility. In saying this it is but just to mention that, in relation to radiant heat (from whence the transition to light is easy), Kirchhoff was preceded, though unconsciously, by our own countryman, Mr. Balfour Stewart. The inference which Kirchhoff drew from Prevost's theory thus extended led him to make a careful comparison of the places of the dark lines of the solar spectrum with those of bright lines produced by the incandescent gas or vapour of known elements; and the coincidences were in many cases so remarkable as to establish almost to a certainty the existence of several of the known elements in the solar atmosphere, producing by their absorbing action the dark lines coinciding with the bright lines observed. Among

other elements may be mentioned in particular hydrogen, the spectrum of which, when traversed by an electric discharge, shows a bright line or band exactly coinciding with the dark line c, and another with the line F.

Mr. Huggins's Researches on Sirius—Determination of Radial Proper Motion.

Now Mr. Huggins found that several of the stars show in their spectra dark lines coinciding in position with c and F; and what strengthens the belief that this coincidence, or apparent coincidence, is not merely fortuitous, but is due to a common cause, is that the two lines are found associated together, both present or both absent; and Kirchhoff's theory suggests that the common cause is the existence of hydrogen in the atmospheres of the sun and certain stars, and its exercise of an absorbing action on the light emitted from beneath.

Now, by careful and repeated observations with a telescope furnished with a spectroscope of high dispersive power, Mr. Huggins found that the F line, the one selected for observation, in the spectrum of Sirius did not exactly coincide with the corresponding bright line of a hydrogen spark, which latter agrees in position with the solar F, but was a *little* less refrangible, while preserving the same general appearance. What conclusion, then, are we to draw from the result? Surely it would be most unreasonable to attribute the dark lines in the spectra of the sun and of Sirius to distinct causes, and to regard their almost exact coincidence as purely fortuitous, when we have in proper motion a *vera causa* to account for a minute difference. And if, as Kirchhoff's labours render almost certain, the dark solar line depends on the existence of hydrogen in the atmosphere of our sun, we are led to infer that that element, with which the chemist working in his laboratory is so familiar, exists and is subject to the same physical laws in that distant star, so distant, that, judging by the most probable value of its annual parallax, light which would go seven times round our earth in one second would take fourteen years to travel from the star. What a grand conception of the unity of plan pervading the universe do such conclusions present to our minds!

Assuming, then, that the small difference of refrangibility observed between the solar F and that of Sirius is due to proper motion, Mr. Huggins concludes from his measures of the minute difference of position that at the time of the observation, Sirius was receding from the earth at the rate of 41·4 miles per second. A part of this was due to the motion of the earth in its orbit; and on deducting the orbital velocity of the earth, resolved in the direction of a line drawn from the star, there remained 29·4 miles per second as the velocity with which Sirius and our sun are mutually receding from each other. Considering the minuteness of the quantity on which the result depends, it is satisfactory to find that Mr. Huggins's results as to the motion of Sirius have been confirmed by the observations of Father Secchi made at Rome with a different instrument.

The determination of radial proper motion in this way is still in its infancy. It is worthy of note that, unlike the detection of transversal proper motion by change of angular position, it is equally applicable to stars at all distances, provided they are bright enough to render the observations possible. It is conceivable that the results of these observations may one day lead to a determination of the motion of the solar system in space, which is more trustworthy than that which has been deduced from changes of position, as being founded on a broader induction, and not confined to conclusions derived from the star in our neighbourhood. Should even the solar system and the nearer stars be drifting along, as Sir John Herschel suggests, with an approximately common motion, like motes in a sunbeam, it is conceivable that the circumstance might thus be capable of detection. To what wide speculations are we led as to the possible progress of our knowledge when we put together what has been accomplished in different branches of science!

Spectrum Observations of the Solar Eclipse.

I turn now to another recent application of spectral analysis. The phenomenon of a total solar eclipse is described by those who have seen it as one of the most imposing that can be witnessed. The rarity of its occurrence and the shortness of its duration afford, however, opportunity for only a hasty study of the phenomena which may then present themselves. Among these, one of the most remarkable, seen indeed before, but first brought prominently into notice by the observers who watched the eclipse of July 7, 1842, consists in a series of mountain-like or cloud-like luminous objects seen outside the dark disk of the moon. These have been seen in subsequent total eclipses, and more specially studied, by means of photography, by Mr. Warren De La Rue in the eclipse of June 18, 1860. The result of the various observations, and especially the study, which could be made at leisure, of the photographs obtained by Mr. De La Rue, proved conclusively that these appendages belong to the sun, not to the moon. The photographs proved further their light to be remarkable for actinic power. Since that time the method of spectral analysis has been elaborated; and it seemed likely that additional information bearing on the nature of these objects might be obtained by the application of the spectroscope. Accordingly various expeditions were equipped for the purpose of observing the total solar eclipse which was to happen on August 17, 1868. In our own country an equatorially mounted telescope, provided with a spectroscope, was procured for the purpose by the Royal Society, which was entrusted to Lieut. (now Captain) Herschel, who was going out to India, one of the countries crossed by the line of the central shadow. Another expedition was organized by the Royal Astronomical Society, under the auspices of Major Tennant, who was foremost in pressing on the attention of scientific men the importance of availing themselves of the opportunity.

Shortly before the conclusion of the meeting of the Association at Norwich last year, the first results of the observations were made known to the meeting through the agency of the electric telegraph. In a telegram sent by M. Janssen to the President of the Royal Society, it was announced that the spectrum of the prominences was very remarkable, showing bright lines, while that of the corona showed none. Brief as the message necessarily was, one point was settled. The prominences could not be clouds in the strict sense of the term, shining either by virtue of their own heat, or by light reflected from below. They must consist of incandescent matter in the *gaseous* form. It appeared, from the more detailed accounts received by post from the various observers, and put together at leisure, that, except in the immediate neighbourhood of the sun, the light of the prominences consisted mainly of three

bright lines, of which two coincided with C and F, and the intermediate one nearly, but, as subsequent researches showed, not exactly with D. The bright lines coinciding with C and F indicate the presence of glowing hydrogen. Several of the other lines were identified with those which would be produced by the incandescent vapour of certain other elements.

This is precious information to have gathered during the brief interval of the total phase, and required, on the part of the observers, self-denial in withdrawing the eye from the imposing spectacle of the surrounding scenery, and coolness in proceeding steadily with some definite part of the inquiry, when so many questions crowded for solution, and the fruits of months of preparation were to be reaped in three or four minutes or lost altogether, especially when, as too often happened, the observations were provokingly interrupted by flying clouds.

But, valuable as these observations were, it is obvious that we should have had long to wait before we could have become acquainted with the usual behaviour of these objects, and their possible relation to changes which may be going on at the surface of the sun, if we had been dependent on the rare and brief phenomenon of a total solar eclipse for gathering information respecting them. But how, the question might be asked, shall we ever be able so to subdue the overpowering glare of our great luminary, and the dazzling illumination which it produces in our atmosphere when we look nearly in its direction, as to perceive objects which are comparatively so faint? Here, again, the science of optics comes in aid of astronomy.

Spectral Examination of the Eclipse Prominences.

When a line of light—such as a narrow slit held in front of a luminous object—is viewed through a prism, the light is ordinarily spread out into a coloured band, the length of which may be increased at pleasure by substituting two or more prisms for the single prism. As the total quantity of light is not thereby increased, it is obvious that the intensity of the light of the coloured band will go on decreasing as the length increases. Such is the case with ordinary sources of light—like the flame of a candle, or the sky, which give a continuous spectrum, or one generally continuous, though interrupted by dark bands. But, if the light from the source be homogeneous, consisting, that is, of light of one degree of refrangibility only, the image of the slit will be merely deviated by the prisms, not widened out into a band, and not consequently reduced in intensity by the dispersion. And, if the source of light emit light of both kinds, it will be easily understood that the images of the slit corresponding to light of any definite refrangibilities which the mixture may contain will stand out, by their superior intensity, on the weaker ground of the continuous spectrum.

Preparations for observations of the kind had long been in progress in the hands of our countryman, Mr. Lockyer. His first attempts were unsuccessful; but, undismayed by failure, he ordered the construction of a new spectroscope of superior power, in which he was aided by a grant from the sum placed annually by Parliament at the disposal of the Royal Society for scientific purposes. The execution of this instrument was delayed by what proved to be the last illness of the eminent optician to whom it was entrusted (the late Mr. Cooke); but, when at last the instrument was placed in his hands, Mr. Lockyer was not long in discovering the object of his two years' search. On the 20th of October last year, in examining the space immediately surrounding the edge of the solar disk, he obtained evidence, by the occurrence of a bright line in the spectrum, that his slit was on the image of one of those prominences the nature of which had so long been an enigma. It further appeared, from an observation made on November 5th (as indeed might be expected from the photographs of Mr. De La Rue, and the descriptions of those who had observed total solar eclipses), that the prominences were merely elevated portions of an extensive luminous stratum of the same general character, which, now that the necessity of the interposition of the moon was dispensed with, could be traced completely round the sun. Notices of this discovery were received from the author by the Royal Society on October 21st and November 3d, and the former was almost immediately published in No. 105 of the "Proceedings." These were shortly afterwards followed by a fuller paper on the same subject.

Meanwhile, the same thing had been independently observed in another part of the world. After having observed the remarkable spectrum of the prominences during the total eclipse, it occurred to M. Janssen that the same method might allow the prominences to be detected at any time; and, on trial, he succeeded in detecting them the very day after the eclipse. The results of his observations were sent by post, and were received shortly after the account of Mr. Lockyer's discovery had been communicated by Mr. De La Rue to the French Academy.

In the way hitherto described, a prominence is not seen as a whole, but the observer knows when its image is intercepted by the slit; and, by varying a little the position of the slit, a series of sections of the prominence are obtained, by putting which together the form of the prominence is deduced. Shortly after Mr. Lockyer's communication of his discovery, Mr. Huggins, who had been independently engaged in the attempt to render the prominences visible by the aid of the spectroscope, succeeded in seeing a prominence as a whole by somewhat widening the slit, and using a red glass to diminish the glare of the light admitted by the slit, the prominence being seen by means of the C line in the red. Mr. Lockyer had a design for seeing the prominences as a whole by giving the slit a rapid motion of small extent; but this proved to be superfluous, and they are now habitually seen with their actual forms. Nor is our power of observing them restricted to those which are so situated that they are seen by projection outside the sun's limb; such is the power of the spectroscopic method of observation that it has enabled Mr. Lockyer and others to observe them right on the disk of the sun—an important step for connecting them with other solar phenomena.

One of the most striking results of the habitual study of these prominences is the evidence they afford of the stupendous changes which are going on in the central body of our system. Prominences, the heights of which are to be measured by thousands and tens of thousands of miles, appear and disappear in the course of some minutes. And a study of certain minute changes of position in the bright line F, which receive a simple and natural explanation by referring them to proper motion in the glowing gas by which that line is produced, and which we see no other way of accounting for, have led Mr. Lockyer to conclude that the gas in question is sometimes travelling with velocities comparable with that of the earth in its orbit. Moreover, these exhibitions of intense action are frequently found

to be intimately connected with the spots, and can hardly fail to throw light on the disputed question of their formation. Nor are chemical composition and proper motion the only physical conditions of the gas which are accessible to spectral analysis. By comparing the breadth of the bright bands (for, though narrow, they are not mere lines) seen in the prominences with those observed in the spectrum of hydrogen rendered incandescent under different physical conditions, Dr. Frankland and Mr. Lockyer have deduced conclusions respecting the pressure to which the gas is subject in the neighbourhood of the sun. I am happy to say that Mr. Lockyer has consented to deliver a discourse during our meeting, in which the whole subject will doubtless be fully explained.

The Great Southern Telescope.

I have dwelt, perhaps, too long on this topic, and I cannot help fearing that I may have been tedious to the many scientific men to whom the subject is already perfectly familiar; yet the contemplations which it opens out to us are so exalted, and the proof which it affords of what can be accomplished by the union of different branches of science is so striking, that I hope I may be pardoned for occupying your time. I cannot, however, leave the subject of astronomy without congratulating the Association on the accomplishment of an object which originated with it, and in the promotion of which it formerly took an active part. It was at the meeting of the Association at Birmingham in 1849, under the presidency of the Rev. Dr. Robinson, that a resolution was passed for making an application to Her Majesty's Government to establish a reflector of not less than 3 feet aperture at the Cape of Good Hope, and to make such additions to the staff of that observatory as might be necessary for its effectual working. This resolution met with the hearty concurrence of the President of the Council of the Royal Society, who suggested that the precise locality in the Southern Hemisphere where the telescope should be erected had best be left an open question. This modification having been adopted by your Council, the application was presented to Earl Russell, then First Lord of the Treasury, by representatives of both bodies early in 1850. A reply was received from Government to the effect that, though they agreed with the Association as to the interest which attached itself to the inquiry, yet there was so much difficulty attending the arrangements that they were not prepared to take any steps without much further inquiry. This reply was considered so far favourable as not to forbid the hope of success if the application were renewed on a suitable opportunity. The subject was again brought before the Association, by Colonel (now General Sir Edward) Sabine, in his opening address as President at the Belfast meeting in 1852. The result was that the matter was again brought before Government by a committee of the British Association, acting in conjunction with a committee of the Royal Society, by means of an application made to the Earl of Aberdeen. By this time the country was engaged in the Russian war, in consequence of which, it was replied, no funds could then be spared; but a promise was given that, when the crisis then impending was past, the matter should be taken up—a promise which the retirement from office and subsequent death of Lord Aberdeen rendered of no avail.

But, though failing in its immediate object, the action of the British Association in this matter has not remained fruitless. A few years later, the subject was warmly taken up at Melbourne, and, after preliminary correspondence between the Board of Visitors of the Melbourne Observatory and the President and Council of the Royal Society, and the appointment by the latter body of a committee to consider and report on the subject, in April, 1864, a proposition was made to the Colonial Legislature for a grant of £5000 for the construction of a telescope, and was acceded to. Not to weary you with details, I will merely say that the telescope has been constructed by Mr. Grubb, of Dublin, and is now erected at Melbourne, and in the hands of Mr. Le Sueur, who has been appointed to use it. It is a reflector of 4 feet aperture, of the Cassegrain construction, equatorially mounted, and provided with a clock-movement. Before its shipment, it was inspected in Dublin by the committee appointed by the Royal Society to consider the best mode of carrying out the object for which the vote was made by the Melbourne Legislature; and the committee speak in the highest terms of its contrivance and execution. We may expect before long to get a first instalment of the results obtained by a scrutiny of the southern heavens with an instrument far more powerful than any that has hitherto been applied to them—results which will, at the same time, add to our existing knowledge, and redound to the honor of the colony by whose liberality this long-cherished object has at last been effected.

Researches on Gun-Cotton.

As I have mentioned an application to the Government on the part of the Association which was not successful, it is but right to say that such is not generally the result: I will refer to one instance. At the Cambridge meeting of the Association, in 1862, a committee, consisting of representatives of the Mechanical and Chemical Sections, was appointed for the purpose of investigating the application of gun-cotton to warlike purposes. At the Newcastle meeting, in the following year, this committee presented their report. It was felt that a complete study of the subject demanded appliances which could be obtained only from our military resources; and at the Newcastle meeting a resolution was passed recommending the appointment of a royal commission. This recommendation was adopted, and, in 1864, a commission was appointed, which was requested to report on the application of gun-cotton to civil as well as to naval and military purposes. The committee gave in their report last year, and that report, together with a more recent return relative to the application of gun-cotton to mining and quarrying operations, has just been printed for the House of Commons.

A substance of such comparatively recent introduction cannot be fairly compared with an explosive in the use of which we have the experience of centuries. Yet, even with our present experience, there are some purposes for which gun-cotton can advantageously replace gunpowder, while its manufacture and storage can be effected with comparative safety, since it is in a wet state during the process of manufacture, and is not at all injured by being kept permanently in water, but merely requires to be dried for use. Even should it be required to store it in the dry state, it is doubtful whether, with the precautions indicated by the chemical investigations of Mr. Abel, any greater risk is incurred than in the case of gunpowder. In the blasting of hard rocks it is found to be highly efficient; while the remarkable results recently obtained by Mr. Abel leave no doubt of its value for explosions such as are

frequently required in warfare. General Hay speaks highly of the promise of its value for small arms; but many more experiments are required, especially as a change in the arm and mode of ignition require a change in the construction of the cartridge. In heavy ordnance, the due control of the rapidity of combustion of the substance is a matter of greater difficulty; and, though considerable progress has been made, much remains to be done before the three conditions of safety to the gun, high velocity of projection, and uniformity of result, are satisfactorily combined.

Deep Sea Soundings.

By the kindness of Dr. Carpenter, I am enabled to mention to you the latest results obtained in an expedition which could not have been undertaken without the aid of Government—an aid which was freely given. Last year, Dr. Carpenter and Professor Wyville Thomson represented to the President and Council of the Royal Society the great importance to zoology and palæontology of obtaining sounding from great depths in the ocean, and suggested to them to use their influence with the Admiralty to induce them to place a gun-boat, or other suitable vessel, at the disposal of those gentlemen, and any other naturalists who might be willing to accompany them, for the purpose of carrying on a systematic course of deep-sea dredging for a month or six weeks. This application was forwarded to the Admiralty with the warm support of the President and Council, and was readily acceded to. The operations were a good deal impeded by rough weather, but, nevertheless, important results were obtained. Dredging was successfully accomplished at a depth of 650 fathoms; and the existence was established of a varied and abundant submarine fauna, at depths which had generally been supposed to be either azoic or occupied by animals of a very low type; and the character of the fauna and of the mud brought up was such as to point to a chalk formation actually going on.

It seemed desirable to carry the soundings to still greater depths, and to examine more fully the changes of temperature which had been met with in the descent. Another application was accordingly made to the Admiralty, in the present year, and was no less readily acceded to than the former; and a larger vessel than that used last year is now on her cruise. I am informed by Dr. Carpenter that dredging has been successfully carried down to more than 2400 fathoms (nearly the height of Mont Blanc), and that animal life has been found, even at that depth, in considerable *variety*, though its *amount* and *kind* are obviously influenced by the reduction of temperature to Arctic coldness. A very careful series of temperature soundings has been taken, showing, on the same spot, a continuous descent of temperature with the depth, at first more rapid, afterward pretty uniform. Thermometers protected from pressure by a plan described by Dr. Miller were found to maintain their character at the great depths reached, the difference between them and the best ordinary thermometers used in the same sounding being exactly conformable to the pressure corresponding with each depth, as determined by the experiments previously made in smaller depths. All the observations hitherto made go to confirm the idea of a general interchange of polar and equatorial water, the former occupying the lowest depths, the latter forming a superficial stratum of 700 or 800 fathoms. The analyses of the water brought up indicate a large proportion of carbonic acid in the gases of the deep waters, and a general diffusion of organic matter.

The Faraday Memorial.

I must turn, for a few moments, to another application recently made to Government, which has not been successful. The application I have in view was made, not by the British Association or other scientific societies in their corporate capacity, but by a body composed of the Presidents of the British Association, and of the Royal and other leading scientific societies; and its object was, not the promotion of science directly, but the recognition of pre-eminent scientific merit. In the history of science, few names, indeed, hold so prominent a place as that of Faraday. The perfect novelty of principle, and recondite nature of many of his great discoveries, are such as to bear the impress of genius of the highest order, and to form an epoch in the advance of science; and, while his scientific labours excited the admiration of men of science throughout the world, his singularly genial disposition, and modest, unassuming character, won for him the love of those who had the happiness of numbering him among their personal friends. At a meeting of the presidents of the scientific societies to which I have alluded, it was resolved to erect a marble statue in memory of Faraday. He was a man of whom England may well be proud, and it was thought that it would be a graceful recognition of his merits if the monument were erected at the public expense. The present Chancellor of the Exchequer, however, did not think it right that the recognition of scientific merit, however eminent, should fall on the taxation of the country, though, even in a pecuniary point of view, the country has received so much benefit from the labours of scientific men. The carrying out of the resolution being thus left to private exertion, a public meeting, presided over by H. R. H. the Prince of Wales, was held in the Royal Institution, an establishment which has the honour of being identified with Faraday's scientific career. At this meeting a committee was formed to carry out the object, and a subscription list commenced. By permission of the secretaries of this association, an office has been opened in the Reception Room, where those members of the association who may be desirous of taking part in the movement will have every facility afforded them.

Recent Discoveries in Chemistry.

In chemistry, I do not believe that any great step has been made within the last year; but perhaps there is no science in which an earnest worker is so sure of being rewarded by making some substantial acquisition to our knowledge, though it may not be of the nature of one of those grand discoveries which from time to time stamp their impress on different branches of science. I may be permitted to refer to one or two discoveries which are exceedingly curious, and some of which may prove of considerable practical importance

Turacine.

The turaco or plantain-eater of the Cape of Good Hope is celebrated for its beautiful plumage. A portion of the wings is of a fine red colour. This red colouring-matter has been investigated by Professor Church, who finds it to contain nearly six per cent. of copper, which cannot be distinguished by the ordinary tests, nor removed from the colouring-matter without destroying it. The colouring-matter is, in fact, a natural organic compound, of which copper is one of the essential constitu-

ents. Traces of this metal had previously been found in animals—for example, in oysters, to the cost of those who partook of them. But, in these cases, the presence of the copper was merely accidental; thus oysters that lived near the mouths of streams which came down from copper mines assimilated a portion of the copper salt, without apparently its doing them either good or harm. But, in the turaco, the existence of the red colouring-matter which belongs to their normal plumage is dependent upon copper, which, obtained in minute quantities with the food, is stored up in this strange manner in the system of the animal. Thus, in the very same feather, partly red and partly black, copper was found in abundance in the red parts, but none, or only the merest trace, in the black.

This example warns us against taking too utilitarian a view of the plan of creation. Here we have a chemical substance elaborated which is perfectly unique in its nature, and contains a metal the salts of which are ordinarily regarded as poisonous to animals; and the sole purpose to which, so far as we know, it is subservient in the animal economy is one of pure decoration. Thus, a pair of fine birds which were kept in captivity lost their fine red colour in the course of a few days, in consequence of washing in the water which was left them to drink, the red colouring-matter, which is soluble in water, being thus washed out; but, except as to the loss of their beauty, it does not appear that the birds were the worse for it.

Artificial Alizarine.

A large part of the calicos which are produced in this country in such enormous quantities are sent out into the market in the printed form. Although other substances are employed, the place which madder occupies among dye-stuffs with the calico-printer is compared by Mr. Schunck to that which iron occupies among metals with the engineer. It appears, from the public returns, that upwards of 10,000 tons of madder are imported annually into the United Kingdom. The colours which madder yields to mordanted cloth are due to two substances, alizarine and purpurine, derived from the root. Of these, alizarine is deemed the most important, as producing faster colours and yielding finer violets. In studying the transformations of alizarine under the action of chemical reagents, MM. Græbe and Liebermann were led to connect it with anthracene, one of the coal-tar series of bodies, and to devise a mode of forming it artificially. The discovery is still too recent to allow us to judge of the cost with which it can be obtained by artificial formation, which must decide the question of its commercial employment. But, assuming it to be thus obtained at a sufficiently cheap rate, what a remarkable example does the discovery afford of the way in which the philosopher, quietly working in his laboratory, may obtain results which revolutionise the industry of nations! To the calico-printer, indeed, it may make no very important difference, whether he continues to use madder, or replaces it by the artificial substance; but what a sweeping change is made in the madder-growing interest! What hundreds of acres, hitherto employed in madder cultivation, are set free for the production of human food, or of some other substance useful to man! Such changes can hardly be made without temporary inconvenience to those who are interested in the branches of industry effected; but we must not, on that account, attempt to stay the progress of discovery, which is conducive to the general weal.

Apomorphia.

Another example of the way in which practical applications unexpectedly turn up when science is pursued for its own sake, is afforded by the result recently obtained by Dr. Matthiessen, in his investigation of the constitution of the opium bases. He found that, by the action of hydrochloric acid on morphia, a new base was produced, which, as to composition, differed from the former merely by the removal of one equivalent of water. But the physiological action of the new base was utterly different from that of the original one. While morphia is a powerful narcotic, the use of which is apt to be followed by subsequent depression, the new base was found to be free from narcotic properties, but to be a powerful emetic, the action of which was unattended by injurious after-effects. It seems likely to become a valuable remedial agent.

In relation to mechanism, this year is remarkable as being the centenary of the great invention of our countryman, James Watt. It was in the year 1769 that he took out his patent involving the invention of separate condensation, which is justly regarded as forming the birth of the steam-engine. Little could even his inventive mind have foreseen the magnitude of the gift he was conferring on mankind in general, and on his own country more particularly. In these days of steamers, power-looms, and railways, it requires no small effort to place ourselves, in imagination, in the condition we should be in without the steam-engine. It needs no formal celebration to remind Britons of what they owe to Watt. Of him, truly it may be said "*si monumentum requiras, circumspice.*"

The Relations between Physical and Biological Sciences.

With reference to those branches of science in which we are more or less concerned with the phenomena of life, my own studies give me no right to address you. I regret this the less because my predecessor, and my probable successor in the presidential chair are both of well-known eminence in this department. But I hope I may be permitted, as a physicist, and viewing the question from the physical side, to express to you my views as to the relation which the physical bear to the biological sciences.

No other physical science has been brought to such perfection as mechanics; and in mechanics we have long been familiar with the idea of the perfect generality of its laws, of their applicability to bodies organic as well as inorganic, living as well as dead. Thus, in a railway collision, when a train is suddenly arrested, the passengers are thrown forward, by virtue of the inertia of their bodies, precisely according to the laws which regulate the motion of dead matter. So trite has the idea become, that the reference to it may seem childish; but, from mechanics, let us pass on to chemistry, and the case will be found by no means so clear. When chemists ceased to be content with the mere ultimate analysis of organic substances, and set themselves to study their proximate constituents, a great number of definite chemical compounds were obtained which could not be formed artificially. I do not know what may have been the usual opinion at that time among chemists as to their mode of formation. Probably it may have been imagined that chemical affinities were indeed concerned in their formation, but controlled and modified by an assumed vital force. But, as the science progressed, many of these organic substances were formed artificially, in some cases from other and perfectly distinct organic substances, in other cases actu-

ally from their elements. This statement must, indeed, be accepted with one qualification. It was stated several years ago, by M. Pasteur, and I believe the statement still remains true, that no substance, the solution of which possesses the property of rotating the plane of polarisation of polarised light, had been formed artificially from substances not possessing that property. Now several of the natural substances which are deemed to have been produced artificially are active, in the sense of rotating the plane of polarisation; and, therefore, in these cases, the inactive artificial substances cannot be absolutely identical with the natural ones. But the inactivity of the artificial substance is readily explained on the supposition that the artificial substance bears to the natural the same relation as racemic acid bears to tartaric—that it is, so to speak, a mixture of the natural substance with its image in a mirror. And when we remember by what a peculiar and troublesome process M. Pasteur succeeded in separating racemic acid into the right-handed and left-handed tartaric acids, it will be at once understood how easily the fact, if it be a fact, of the existence, in the natural substance, of a mixture of two substances, one right-handed and the other left-handed, but otherwise identical, may have escaped detection. This is a curious point, to the clearing up of which it is desirable that chemists should direct their attention. Waiving, then, the difference of activity or inactivity, which, as we have seen, admits of a simple physical explanation, though the correctness of that explanation remains to be investigated, we may say that, at the present time, a considerable number of what used to be regarded as essentially natural organic substances have been formed in the laboratory. That being the case, it seems most reasonable to suppose that, in the plant or animal from which those organic substances were obtained, they were formed by the play of ordinary chemical affinity, not necessarily nor probably by the same series of reactions by which they were formed in the laboratory, where a high temperature is commonly employed, but still by chemical reactions of some kind, under the agency, in many cases, of light, an agency sometimes employed by the chemist in his laboratory. And, since the boundary line between the natural substances which have and those which have not been formed artificially, is one which, so far as we know, simply depends upon the amount of our knowledge, and is continually changing as new processes are discovered, we are led to extend the same reasoning to the various chemical substances of which organic structures are made up.

But do the laws of chemical affinity, to which, as I have endeavoured to infer, living beings, whether vegetable or animal, are in absolute subjection, together with those of capillary attraction, of diffusion, and so forth, account for the formation of an organic structure, as distinguished from the elaboration of the chemical substances of which it is composed? No more, it seems to me, than the laws of motion account for the union of oxygen and hydrogen to form water, though the ponderable matter so uniting is subject to the laws of motion during the act of union just as well as before and after. In the various processes of crystallisation, of precipitation, and so forth, which we witness in dead matter, I cannot see the faintest shadow of an approach to the formation of an organic structure, still less to the wonderful series of changes which are concerned in the growth and perpetuation of even the lowliest plant. Admitting, to the full, as highly probable, though not completely demonstrated, the applicability to living beings of the laws which have been ascertained with reference to dead matter, I feel constrained, at the same time, to admit the existence of a mysterious *something* lying beyond—a something, *sui generis*, which I regard, not as balancing and suspending the ordinary physical laws, but as working with them and through them to the attainment of a designed end.

What this *something*, which we call life, may be, is a profound mystery. We know not how many links in the chain of secondary causation may yet remain behind; we know not how few. It would be presumptuous, indeed, to assume, in any case, that we had already reached the last link, and to charge with irreverence a fellow worker who attempted to push his investigations yet one step further back. On the other hand, if a thick darkness enshrouds all beyond, we have no right to assume it to be impossible that we should have reached even the last link of the chain; a stage where further progress is unattainable, and we can only refer the highest law at which we stopped to the fiat of an Almighty Power. To assume the contrary as a matter of necessity, is, practically, to remove the First Cause of all to an infinite distance from us. The boundary, however, between what is clearly known and what is veiled in impenetrable darkness, is not ordinarily thus sharply defined. Between the two there lies a misty region, in which loom the ill-discerned forms of links of the chain which are yet beyond us. But the general principle is not effected thereby. Let us fearlessly trace the dependence of link on link as far as it may be given us to trace it; but let us take heed that, in thus studying second causes, we forget not the First Cause, nor shut our eyes to the wonderful proofs of design which, in the study of organised beings especially, meet us at every turn.

Truth we know must be self-consistent, nor can one truth contradict another, even though the two may have been arrived at by totally different processes—in the one case, suppose, obtained by sound scientific investigation, in the other case taken on trust from duly authenticated witnesses. Misinterpretations, of course, there may be on the one side or on the other, causing apparent contradictions. Every mathematician knows that in his private work he will occasionally, by two different trains of reasoning, arrive at discordant conclusions. He is at once aware that there must be a slip somewhere, and sets himself to detect and correct it. When conclusions rest on probable evidence, the reconciling of apparent contradictions is not so simple and certain. It requires the exercise of a calm, unbiassed judgment, capable of looking at both sides of the question; and oftentimes we have long to suspend our decision, and seek for further evidence. None need fear the effect of scientific inquiry carried on in an honest, truth-loving, humble spirit, which makes us no less ready frankly to avow our ignorance of what we cannot explain, than to accept conclusions based on sound evidence. The slow but sure path of induction is open to us. Let us frame hypotheses if we will: most useful are they when kept in their proper place, as stimulating inquiry. Let us seek to confront them with observation and experiment, thereby confirming or upsetting them, as the result may prove; but let us beware of placing them prematurely in the rank of ascertained truths, and building further conclusions on them, as if they were.

When, from the phenomena of life, we pass on to those of mind, we enter a region still more profoundly mysterious. We can readily imagine that we may here be dealing with phenomena altogether transcending

those of mere life, in some such way as those of life transcend, as I have endeavoured to infer, those of chemistry and molecular attractions, or as the laws of chemical affinity, in their turn, transcend those of mere mechanics. Science can be expected to do but little to aid us here, since the instrument of research is itself the object of investigation. It can but enlighten us as to the depth of our ignorance, and lead us to look to a higher aid for that which most nearly concerns our well-being.

Section B.

ADDRESS

TO THE

CHEMICAL SECTION.

AUGUST 19, 1869.

BY DR. DEBUS, F.R.S., PRESIDENT.

I BELIEVE it has been the custom with many of my predecessors in this office to place before the members of the British Association a Report of the progress of Chemistry during the year preceding their election. In attempting to follow their example, I soon found that it would be impossible for me, without making too great a demand upon your time, to give even a bare outline of the more important chemical work done during the year. A science, the report of whose yearly advances fills about 1000 large octavo pages, cannot, by any powers of mine, have its progress chronicled in an address of half an hour's duration. The best course open to me under such circumstances is to direct your attention to the ideas which at present guide chemists in their researches, to place in a clear light the objects they are striving to attain, and to indicate the direction of scientific thought of our time. To do this is by no means an easy task; for the more manifold and diversified the objects of a science become—the more numerous and extensive its relations with other branches of knowledge, the more difficult it becomes to draw a picture of its actual condition.

It is always an excellent recommendation to a theory or hypothesis when, amongst the cultivators of the science to which it pertains, very little difference of opinion exists as regards its admissibilty and scientific value. This is, in a high degree, the case with regard to the atomic theory. The vast majority of chemists, I believe, accept this theory as the most suitable exponent of the fundamental truths of their science; and certainly, if the quality of the tree may be judged by its fruit, there is no other view which furnishes a clearer image to our minds of the chemical constitution of bodies, and, at the same time, conducts to the discovery of so many important facts and relations. By Dalton's profound hypothesis, all bodies are supposed to be composed of atoms of infinitely small dimensions. But these atoms are supposed not to be single; two or more of them are held together by certain forces, and thus constitute what is called a molecule. One atom of carbon, one atom of calcium, and three atoms of oxygen, joined together by the force called chemical affinity, constitute a molecule of carbonate of lime. Vast numbers of such molecules, bound to each other by the force of cohesion, form a visible piece of chalk. If a chemist wishes to examine a body, his first endeavour is to ascertain of what sort of atoms the body is formed. This is a mere matter of experiment. He next determines how many of such atoms are contained in each molecule of the body, and, finally, he ascertains how these atoms are arranged, or, more correctly, combined within the molecule; for it is quite clear that a substance like saltpetre, which contains one atom of nitrogen, one of potassium, and three of oxygen, may have these atoms arranged in very different manners, and still have the same composition. We might assume the potassium and nitrogen in more intimate union, nearer to each other than they are to oxygen, or we might consider nitrogen and oxygen more closely packed together, and, so to speak, attached as a whole to the potassium; in both cases, saltpetre would have in each molecule the same number of atoms, and the weight of the molecule would be the same. The three determinations just mentioned are of fundamental importance to the chemist; not that such inquiries are the only ones which interest him, for we shall, in the sequel, notice others of almost equal importance.

Nor must it be supposed that questions of this nature are of quite a modern date; for Leucippus, 500 B.C., appears to have sought to explain the nature of things, by the assumption that they are formed by the union of small particles, which latter received the name of atoms from Epicurus. It is true the notion of atoms, as conceived by the Grecian philosophers, is not quite the same as ours, but their speculations contain our notions pretty much in the same way as the acorn contains the oak-tree.

The determination of the quality of the atoms in a molecule, or the analysis of the latter, has not undergone many changes during the last few years; and the same may be said about finding of the relative weight of a molecule, or the determination of the number of atoms which are contained in it. With regard to the latter point, however, it may be mentioned that Avogadro's hypothesis, according to which equal volumes of gaseous substances, measured at the same temperature and pressure, contain the same number of molecules, guides us chiefly in assigning to each molecule its relative weight and its number of atoms; this hypothesis has won more and more the confidence of chemists, and it is now admitted to hold good in nearly all well-examined cases.

Our views relative to the combinations of atoms in molecules, and our methods of ascertaining this arrangement, have, however, undergone great alterations, and received great additions, during the last ten or fifteen years. To a consideration of these changes I will now, for a short time, invite your attention. Since our modern views, however, originated, in a great measure, from the study of organic bodies, and since the majority of chemists now devote their time and labour thereto, I shall confine my remarks principally to the organic branch of the subject.

Eighteen years ago, Prof. Williamson read before the members of this Association a remarkable paper, which contained the germ of our modern chemical views, and was the cause of many discoveries. He proposed to regard three large classes of bodies, acids, bases, and salts from the same point of view, and to compare their chemical properties with those of one single elected substance. For this term of comparison he chose water. Now water is composed of three atoms—two of hydrogen and one of oxygen. Williamson showed that all oxygen acids—all oxygen bases, and the salts resulting from a combination of the two—can, like water, be considered to be composed of three parts, or radicals, two of the radicals playing the part of the

hydrogen atoms in water, and the third that of the atom of oxygen, thus:—

$\left.\begin{matrix}H\\H\end{matrix}\right\}O$	$\left.\begin{matrix}K\\H\end{matrix}\right\}O$	$\left.\begin{matrix}NO\\H\end{matrix}\right\}O$	$\left.\begin{matrix}NO\\K\end{matrix}\right\}O$
Water.	Potassic hydrate.	Hydric nitrite.	Potassic nitrite.

Potassic hydrate is water which has one of its atoms of hydrogen replaced by an atom of potassium; hydric nitrite is water which has one atom of hydrogen replaced by nitric oxide; and potassic nitrite is water with one of its hydrogen atoms replaced by nitric oxide, and the other by potassium. This speculation, as every chemist knows, is well supported by experiments; it embraces three large classes of bodies which, till then, had been considered as distinct. M. Gerhardt, in 1853, extended Williamson's views, by distinguishing two other types of molecular structure, represented, respectively, by hydrogen and ammonia, and succeeded, by help of the radical theory, in arranging the majority of the then known substances under one or the other of the three types already mentioned.

Like every theory which is in harmony with experience, the above considerations led to results of unexpected importance; for it soon became apparent that the radicals which thus replace hydrogen in water are not all of the same chemical value. If we place together the formulæ of hydric nitrite and carbonic acid—

$\left.\begin{matrix}NO\\H\end{matrix}\right\}O$	$CO\}O$
Hydric nitrite.	Carbonic acid.

we perceive, at once, that the atomic group NO has replaced one atom of hydrogen in one molecule of water, and carbonic oxide, CO, two atoms of hydrogen in one molecule of water. Nitric oxide (NO) is, therefore, said to be equivalent to one atom of hydrogen, and carbonic oxide (CO) equivalent to two atoms of hydrogen. The radical of phosphoric acid [PO] is found to be equivalent to three atoms of hydrogen. Professor Odling was one of the first to observe this difference in the equivalence of atoms, and groups of atoms, or compound radicals, as they are termed, a difference which he marks, as shown in the following examples:—

Radicals.

Equivalent to one atom of hydrogen.		Equivalent to two atoms of hydrogen.	
Nitric oxide	$(NO)'$	Carbonic oxide	$[CO]''$
Methyl	$(CH_3)'$	Methylene	$[CH_2]''$
Ethyl	$(C_2H_5)'$	Ethylene	$[C_2H_4]''$

The notion of equivalence enabled Professor Kekulé to form most interesting speculations on the constitution of organic bodies, and to explain the relation between composition and equivalence of such radicals as methyl, CH_3, ethyl, C_2H_5, methylene, CH_2, ethylene, C_2H_4, and acetylene, C_2H_4.

If from one molecule of marsh-gas, CH_4, one atom of hydrogen is abstracted, the residue, CH_3, called methyl, can combine with an atom of hydrogen again, and produce the original marsh-gas molecule. But methyl, instead of combining with an atom of hydrogen, can unite with an atom of chlorine, or an atom of bromine—that is to say, the place of the atom of hydrogen can be taken by an atom of chlorine or bromine. Methyl being thus equivalent to an atom of hydrogen, is said to be monovalent. If from a molecule of marsh-gas two atoms of hydrogen are removed, the residue, CH_2, called methylene, can again unite with two atoms of hydrogen, or, instead of hydrogen, two atoms of chlorine or bromine, and from the compounds CH_4, $CHCl_2$, CH_2Br_2 respectively. Methylene, therefore, being equivalent to two atoms of hydrogen, is termed divalent. The radical CH, left after the abstraction of three atoms of hydrogen from marsh-gas, is able to reproduce with three atoms of hydrogen one molecule of marsh-gas, or to combine with three atoms of chlorine, and form chloroform, $CHCl_3$. The residue, CH, is thus trivalent or equivalent to three atoms of hydrogen. In the same manner carbon is found to be tetravalent or equivalent to four atoms of hydrogen. But carbon, formen [CH], methylen, CH_2, methyl, CH_3, not only combine with hydrogen, chlorine, or other elements according to their equivalence, but also amongst themselves, and thus produce the so-called hydrocarbons, native as well as artificial. Methyl combines with methyl and produces dimethyl, or better known as ethylic hydride, $CH_3+CH_3=C_2H_6$; methylene combines with methylene, and forms ethylene, $CH_2+CH_2=C_2H_4$. Methylene is divalent, and methyl nonavalent; therefore methylene combines with two equivalents of methyl and forms propylic hydride, C_3H_8, $CH_2+2CH_3=C_3H_8$. Six equivalents of formen are supposed to be contained in benzol $[C_6H_6]$, $6CH=C_6H_6$.

What has been said of marsh-gas also applies to ammonia and water. Ammonia, NH_3, minus one atom of hydrogen, forms the monovalent radical, NH_2, minus two atoms of hydrogen, the divalent radical, NH, and nitrogen itself trivalent, that is to say, it can replace three atoms of hydrogen in compounds, or can combine with three atoms of hydrogen. Water minus one atom of hydrogen produces the monovalent radical hydroxyl, HO, and water without both atoms of hydrogen gives us divalent oxygen. These radicals, NH_2, NH, N, HO, and O, can combine with each other, and with methyl, methylene, formen, and carbon respectively in different proportions. Thus methyl, methylene, and hydroxyl are contained in common alcohol. The union of methyl, carbon, oxygen, and hydroxyl gives acetic acid, $C_2H_4O_2$,

$$CH_3+C+O+HOC_2=H_4O_2.$$

Glycocoll is considered as a combination of methylene amidogen $[NH_2]$, carbon, oxygen, and hydroxyl:—

$$CH_2+NH_2+C+O+HO=C_2H_5NO_2=\text{glycocoll.}$$

The radicals C, CH, CH_2, CH_3, HO, O, N, NH, NH_2, and CO, are considered to form the proximate constituents of the most important organic compounds. It often happens that, from the union of the same radicals, two or more bodies of the same composition, but differing from one another in properties, result. Glycocoll, as well as glycolamide, contain the radicals methylene, hydroxyl, carbonic oxide, and amidogen, NH_2. In such cases the nature of the compound depends on the arrangement of the radicals, as may be seen by the following formulæ:—

$$CH_2.NH_2.CO.HO=C_2H_5NO_2=\text{glycocoll,}$$
$$CH_2.HO.CO.NH_2=C_2H_5NO_2=\text{glycolamide.}$$

Now, the great problem with whose solutions scientific chemists are occupied, is *to determine, first, what sort of radicals of the above nature are contained in a given organic body; and, second, how these radicals are grouped amongst each other.*

There are several ways of solving this problem. The molecule may be built up by placing the radicals which are supposed to exist in it under suitable conditions in contact. Two molecules of iodopropionic acid placed together with metallic silver will lose their

iodine, and the residues of the two molecules remain united. A new acid, called adipic acid, is thus formed.

$$\text{Iodopropionic acid} \begin{cases} CO.HO \\ CH_2 \\ CH_2I \end{cases} + Ag = 2AgI + \begin{cases} COHO \\ CH_2 \\ CH_2 \\ CH_2 \\ CH_2 \\ COHO \end{cases} = \text{adipic acid.}$$

$$\text{Iodopropionic acid} \begin{cases} CH_2I \\ CH_2 \\ COHO \end{cases}$$

We know, therefore, the radicals of adipic acid and their arrangement if we possess the same knowledge with regard to iodopropionic acid.

The above elegant synthesis has lately been performed by Professor Wislicenus of Zurich. M. Berthelot has now succeeded in producing representatives of the principal classes of hydrocarbons from the element of carbon and hydrogen, and Messrs. Bauer and Versow of Vienna have prepared from amylene, C_5H_{10}, a compound, $C_{10}H_{16}$, which appears to be identical with terebene, a body closely allied to turpentine.

Another way to determine the proximate constituents of molecules is to take the little structures to pieces and to form a judgment of their constitution from the radicals which thus can be extracted. This plan has been adopted by Mr. Chapman, and described by him at one of our former meetings.

The more common and more reliable method for the determination of the grouping of atoms in molecules is, however, the replacement of one or more of them by atoms of another kind, and the careful examination of the properties of the bodies thus formed. M. Gautier has recently obtained a new substance of the same composition as acetonitrile, which he calls methcarbylamine. According to their formation, acetonitrile, as well as methcarbylamine, can be considered as combinations of cyanogen and methyl=CH_3CN. The two bodies, however, do not possess the same properties. If they are heated with potassic hydrate and water, methcarbylamine produces formic acid and methylia, whereas the same reagents cause acetonitrile to form acetic acid and ammonia. Thus—

$$\underbrace{C_2H_3N}_{\text{Acetonitrile.}} + \underbrace{2H_2O}_{\text{Water.}} = \underbrace{C_2H_4O_2}_{\text{Acetic Acid.}} + NH_3$$

$$\therefore \underbrace{C_2H_3N}_{\text{Methcarbylamine.}} + 2H_2O = \underbrace{CH_2O_2}_{\text{Formic Acid.}} + \underbrace{N\begin{cases} CH_3 \\ H_2 \end{cases}}_{\text{Methylia.}}$$

In the first case, the radical methyl remains after the decomposition in union with carbon, and in the second case in combination with nitrogen. Accordingly, it is supposed that the same arrangement prevails in the undecomposed molecules, and with this supposition all the other properties of methcarbylamine and acetonitrile agree. In symbols these relations are expressed as follows:

$$N\begin{cases} C'' \\ CH_3 \end{cases} = \text{methcarbylamine.}$$

$$N\begin{cases} C_2H_3 \end{cases} = \text{acetonitrile.}$$

This case of isomerism is most interesting, inasmuch as it furnishes a most instructive lesson on the grouping of atoms. The homologous bodies of methcarbylamine in the ethyl and propyl series have also been obtained.

Isomerism, indeed, has received much attention during the last year, and a great many interesting discoveries have resulted. Of these, one more example may be mentioned. We know two compounds of the formula CN_2H_4O—the one is ammonic cyanate, and the other urea. Until recently, only one corresponding sulphur-compound, ammonic sulphocyanate, was known. Professor Reynolds has succeeded in obtaining the true sulphur-urea, a body isomeric to ammonic sulphocyanate.

Thus every year produces results which improve our conceptions of the atomic and molecular constitution of bodies. And, as our knowledge improves, new questions suggest themselves, and our power over the elements increases. It has already become possible to prepare, in the laboratory, bodies of a very complex character, and which, a few years ago, were only found in the bodies of animals or plants.

Alizarine, the beautiful compound of the madder root, has been obtained, by artificial means, in the course of the year, by MM. Liebermann and Græbe. Results of such a nature render it highly probable that, at no distant period, it will be in our power to render nearly all, if not all, the substances found in plants and animals. Here I must not be misunderstood. Organic structures, such as muscular fibre, or the leaves of a tree, the science of chemistry is incapable of producing; but molecules like those found in a leaf, or in the stem of a tree, will, no doubt, one day be manufactured from their elements.

I must not conclude this address without reference to two or three papers of great importance.

Professor Bunsen, of Heidelberg, has published a paper on the washing of precipitates. Every one acquainted with practical chemistry knows how much time is often lost in waiting for a liquid to pass through a filter. Bunsen found the rate of filtration nearly proportional to the difference between the pressures on the upper and lower surfaces of the liquid. If, accordingly, the funnel be fixed air-tight, by means of a perforated cork, to the neck of a bottle, and the air exhausted in the bottle, the liquid will run faster through the filter in proportion to the diminution of the pressure in the bottle. Comparative experiments, some made according to the old, and others according to the new method, showed that the filtration, washing, and drying of the precipitate, which took seven hours by the old plan, could be performed, by filtration into an exhausted bottle, in thirteen minutes. But a saving of time is not the only advantage of the improved method of collecting and washing precipitates. A more perfect washing, with less water than is required by the common way of proceeding, is by no means the least recommendation of Bunsen's ingenious method.

A very important paper has been published by Professor Liebig, on the improvement of the nourishing qualities of bread. Certain quantities of phosphates and other salts form necessary ingredients of wholesome food. Now, it is well known that most of these salts, which are naturally in wheat, remain with the husk. Liebig proposes to add salts, of a nature similar to those remaining in the husk, to the flour, and, at the same time, to substitute, for the carbonic acid developed by fermentation, gas liberated from iodic carbonate. The bread prepared according to Liebig's recommendation is said to be of excellent quality, and to exceed bread made by the common plan in value.

Mr. Graham, of Her Majesty's Mint, has continued his researches on the absorption of hydrogen by palladium. Palladium appears to be able to absorb more than 900 times its volume of hydrogen, and to form a combination which consists of nearly equal equivalents of the two elements. Hydrogenium, as Mr. Graham calls the

combined hydrogen, acts in this case like a metal, and thus the opinion held by some scientific men, that hydrogen constitutes the vapor of a metal, receives confirmation. The specific gravity of hydrogenium, as contained in the alloy, was found to be 1·95. These experiments are remarkable in more than one respect. The palladium which absorbs and combines with the hydrogen, does not change its state of aggregation, but remains solid, and expands, as if it had been heated. The nodules of the palladium have, consequently, changed their relative positions, and combined with hydrogen, whilst the continuity of the metal remained intact.

The last paper to which I have to draw your attention, is to the beautiful paper by Professor Tyndall, on a new method of decomposing gaseous substances by means of light. Tyndall's experiments bring us face to face with the motions of atoms of molecules, and the relation of these motions to chemical decomposition. They will, no doubt, at some future time, furnish valuable materials to chemical dynamics.

PRELIMINARY REPORT OF THE COMMITTEE APPOINTED FOR THE

DETERMINATION OF THE GASES EXISTING IN SOLUTION IN WELL WATERS.*

BY DR. E. FRANKLAND, F.R.S., AND HERBERT McLEOD, F.C.S.

In consequence of the investigation being far from complete, this report must be considered as merely a preliminary one; a more detailed account of the results obtained and the inferences to be drawn from them must be postponed till a future occasion.

The apparatus employed in these and other experiments was described at the last meeting of the Chemical Society, and will shortly be published in the *Journal*.†

In collecting the waters, it is, of course, of the greatest importance that they should be prevented from coming in contact with the air, otherwise serious errors might be produced in the determination of the gases dissolved. In order to avoid these errors, the tap de-

	I. Rain-water.	II. Water from cistern of Royal College of Chemistry, supplied by Grand Junction Company.	III. Water from well, in chalk, 367 ft. deep, at Messrs. Barclay and Perkins's Brewery, Southwark.	IV. Water from well not down to chalk, in course of construction, 143½ ft. deep, at Messrs. Barclay and Perkins's Brewery, Southwark.	V. Water from chalk well at Worthing.	VI. Water from surface well to face of the chalk, 27—30 ft. deep, at Mr. Hill's Brewery, Deal. In the town. Influenced by the tide.	VII. Water from chalk well 115 ft. deep. Waterworks, Deal, surrounded by cultivated fields. Not influenced by tide.	VIII. Water from Waterworks, Deal, drawn from main about a mile from the reservoir.
Temperature at time of collection (° C.)	15·5	14·8	12·1	12	(?)	11·9	14·8	17·2
Mean of	2 expts.	2 expts.	2 expts.	4 expts.	2 expts.	2 expts.	2 expts.	2 expts.
Volumes of gases in 100 volumes of water. Nitrogen	1·382	1·397	2·030	1·973	1·552	1·704	1·548	2·241
Oxygen	0·673	0·620	0·029	0·018	0·446	0·023	0·580	0·796
Carbonic anhydride	0·135	4·239	5·765	3·814	5·452	10·252	5·055	4·413
Total	2·190	6·256	7·824	5·805	7·450	11·979	7·183	7·450
Solubility of nitrogen in 100 volumes of distilled water (Bunsen)	1·468 at 15·5°	1·478 at 15°	1·549 at 12°	1·549 at 12°	—	1·549 at 12°	1·478 at 15°	1·441 at 17°

The experimental results, of which the above numbers are the means, were tolerably concordant. The greatest differences between the results of different experiments are the following:—In water No. IV., experiment 3 gave 0·140 parts more nitrogen than experiment 2; in water No. VII., the oxygen obtained in the second experiment was 0·045 in excess of the quantity obtained in the first; in water No. III., the second experiment gave 0·760 parts more carbonic anhydride than the other. Since this last was done, the mode of collection and removal of the gases have been improved.

livering the water from the pumps is connected, by means of a caoutchouc tube, with a tubulure at the bottom of a tin cylinder, about 10 inches high, and 7 in diameter. The water is turned on, and allowed to flow over the edge of the vessel; thus only the surface of the water is exposed to the action of the air, and the liquid at the lower part of the vessel is protected by the upward current and continual overflow.

The bottles used for collecting the waters hold a little more than 100 c.c., and a separate quantity is used for each experiment. Into each bottle a piece of glass tube bent in the form of a U is introduced; one end of the tube is sealed, and, in the closed limb, a bubble of air is confined by mercury, which fills the open limb and the bend. In the collection of each water, four of these bottles are lowered, by means of pieces of string, into the tin vessel while the water is flowing over its edge. After being filled, each bottle is carefully examined, and, if any bubbles of gas adhere to the sides, they must be removed. The bottles are then again lowered into the vessel, and the temperature observed. A syphon is now passed to the bottom of one of the bottles, and, after it has drawn two or three hundred cubic centimetres of water through the bottle, it is placed into the second. The first bottle is now raised, and, while its neck is still under the water, a slightly-greased stopper is put into the neck, and carefully pressed down. This force compresses the air contained in the glass tube, and, if the pressure is sufficient, it prevents the escape of gas from the water—a precaution which, in some cases, is very necessary. The sy-

* Read before the British Association, Exeter meeting, Section B.

† See Chemical News, vol. xx., p. 20 (*Am. Repr., Sept.*, 1869, *page* 158).

phon is then transferred from the second into the third bottle, and the second is closed and removed. When the four bottles have been filled, the stoppers are covered with ground caps. The caps are next filled with mercury, through small holes at their tops, which are afterwards closed with glass stoppers.

The gases should be removed from the waters as soon after collection as possible. In the following cases, the greatest length of time which was allowed to elapse between these operations was five days; but usually the removal of the gases was effected the day after the collection.

With so few results as have been obtained up to the present, it will be impossible to do more than point out the small quantity of oxygen in the waters from deep wells as compared with those from shallow ones, and with rain and river waters. The quantity of nitrogen is also very remarkable as being, in all the cases, except the river and rain waters, in excess of the amount absorbable by distilled water. To show this, there is introduced into the foregoing table numbers from Bunsen's gasometry, indicating the quantities of nitrogen absorbable by 100 volumes of distilled water at the temperatures which are nearest to those at which the waters were collected. The reasons of this apparent anomaly will be investigated during the course of the ensuing year, and it is hoped that, by the next meeting of the Association, a much larger amount of information will have been obtained. The prosecution of the experiments has been much hindered by the necessity of perfecting the apparatus for the removal of the gases and the means of collection, so that it was not until after the commencement of July that any systematic work could be commenced.

REPORT ON THE CHEMICAL NATURE OF CAST-IRON.*

BY MESSRS. F. A. ABEL, F.R.S., D. FORBES, F.R.S., AND A. MATTHIESSEN, F.R.S.

The Committee have to report that, during the past year, some material progress has been made in this research. They entrusted the preparation of pure iron to Dr. Matthiessen, who carried out this part of the investigation in conjunction with M. Prus-Szczepanowski. From a series of experiments, which are detailed in the Appendix, pure iron appeared to be obtainable in considerable quantities; and we hope, if the Committee be re-appointed, that next year a great deal of valuable information will be obtained on the chemical nature and physical properties of pure iron and its alloys. The iron obtained by the process described in the Appendix is almost absolutely pure, containing only a minute trace of sulphur. According to an analysis made by Professor Abel, the iron contained, in 100 parts, only 0·00025 parts of sulphur. In another analysis, the amount of sulphur found by M. Prus-Szczepanowski amounted to 0·0007 per cent. Phosphorus and silicon were carefully tested for by both analysts, and found to be entirely absent. The amount of substance taken for each analysis was about 30 grammes.

Appendix.

ON THE PREPARATION OF PURE IRON.

BY A. MATTHIESSEN, F.R.S., AND S. PRUS-SZCZEPANOWSKI.

After numerous trials, the general outline of which was given in the report of last year, the following method was found to yield nearly absolutely pure iron, in quantities sufficient for the purpose of this research. Pure dried ferrous sulphate, and pure dried sodium sulphate, are mixed in nearly equal proportions, and introduced gradually into a red-hot platinum crucible. The mass is kept in fusion until the evolution of sulphurous acid gas ceases. The crucible is then allowed to cool, and the fused mass extracted with water. If the heat be properly regulated, the whole of the iron is left as a very fine crystalline oxide. This oxide is thoroughly washed, by decantation, to remove every trace of the sodium sulphate, and, after being dried, is reduced, by hydrogen, in a platinum crucible; the spongy iron thus obtained is then pressed into solid buttons, and melted in lime crucibles with the oxyhydrogen blowpipe.

Before proceeding further, it will be as well to mention the precautions observed in obtaining the raw material in the purest state. The commercial pure ferrous sulphate was freed from every trace of copper by leading sulphuretted hydrogen through the warm acetic acid solution. After filtration the ferrous sulphate was twice re-crystallised, and dried, first in a water-bath, then in an air-bath. The commercial crystallised sodium sulphate was re-crystallised several times to get rid of the last trace of chloride of sodium, and then heated on a water-bath to melt the crystals. As is well-known, anhydrous sodium sulphate separates out from this solution, which was scooped out from time to time, dried on an air-bath, and powdered. The purification of the sodium sulphate from chloride of sodium was found to be necessary, owing to the fact that when fusions were made with sodium sulphate containing that salt, the resulting oxide of iron always contained platinum. The hydrogen used for the reduction of the iron, as well as for the blowpipe, was prepared by the action of sulphuric acid on zinc, and purified by leading the gas through two wash bottles—the first containing nitrate of silver and strong nitric acid, and the second caustic soda and acetate of lead—both bottles being half filled with pieces of pumice-stone. The oxygen was prepared by heating a mixture of chlorate of potassium with 15 to 20 per cent of black oxide of manganese, and washed by leading through caustic soda. All connections were made of glass, lead, or pure india-rubber tubing.

The fusion took place in a large platinum crucible (the contents of which are rather more than ½ a litre), enclosed in the usual manner in a clay crucible. The dimensions were such, therefore, that about a kilo. and a half of the mixture could be fused at each operation. After fusion, the crucible is allowed to cool; it is then boiled out with distilled water, and the accumulated product of 6 to 8 fusions washed by decantation with boiling distilled water. The crystalline oxide settles very quickly, and thus allows of a very rapid and thorough washing. The washing was in every case continued several times after the wash waters ceased to give any turbidity with barium nitrate. It is worthy of mention that the above process to prepare pure oxide from the mixture of mixed sulphates yields the purest oxide we as yet obtained. The reduction of the oxide thus formed was made in a covered platinum crucible, heated by means of a large Bunsen burner. The hydrogen was introduced by means of a platinum tube, reaching through the cover to the bottom of the crucible. The gas, purified as described above, and dried by chloride of calcium, was always

* Read before the British Association, Exeter Meeting, Section B.

kept slightly in excess, a constant stream of gas being obtained by not using the generator, but two large gas-holders joined together, the contents of each being about 600 litres (20 cubic feet); two other gas-holders of similar capacity being used for the storage of the oxygen, the one being used to collect the gas from the retort, the other to contain the gas purified by passing it through a strong solution of caustic soda.

The resulting spongy iron was pressed into solid buttons, by means of a strong coining press and a diamond mortar, the cylinder of which being about 70 m.m. in height, the iron, when pressed, forms a cylinder of about 15 m.m. in height, and weighs about 20 grammes. The melting of the compressed iron took place in lime crucibles, the lime having been previously burnt, slacked, and reburnt, thus forming a fine, impalpable powder, which was compressed in the crucible mould.

The best method of fusion was found to be as follows:—The lime crucible was placed in a slanting position on a piece of lime. One of the oxyhydrogen blowpipes used in the process played on the outside of the crucible whilst the flame of the other was directed inside. When white-hot, a cylinder of the compressed iron was thrown into it. It quickly melts, but at the expense of a large quantity of the iron which is oxidised. The amount lost by the oxidation varies between 25 to 50 per cent. In order to obtain a good solid button of melted iron, it is necessary to cool it in an atmosphere of hydrogen, which is easily obtained simply by turning off the oxygen from the blowpipe playing inside the crucible. The button thus obtained weighs about 15 grammes. On analysis, it was found that the buttons were free from sulphur, phosphorus, silicon, and calcium.

The preparation on a large scale of the pure ferrous sulphate and sodium sulphate was kindly undertaken for us by Mr. J. Williams, who prepared for us more than a hundred weight of each of these substances. We are also indebted to Mr. W. G. Underhay for the use of his large coining press for the pressing of the lime crucibles and the iron buttons.

THE ELECTRO-DEPOSITION OF IRON.

In the Chemical Section of the British Association, Dr. Jacobi, so well known as the earliest worker in the field of electro-metallurgy, read a paper "*On the Electro-Deposition of Iron.*"

The paper was illustrated by a series of beautiful specimens; among these may be mentioned a medallion of the learned professor, 800 m.m. in diameter. The details of the process were not as full as could be desired. Dr. Jacobi stated that he preferred to employ a dilute solution of the double sulphate of iron and sulphate of potash, soda, or magnesia.

A very low battery power was employed—usually two small Smee's elements.

The moulds may be gutta-percha, wax, or, in fact, any material with which the electro-metallurgist is familiar.

Nature of the Deposit.—The iron has a beautiful lustre, and a silky texture. Exact experiments on its conductivity and tensile strength have yet to be made.

Employment of the Electro-Iron in the Arts.—As we have already stated, Dr. Jacobi showed specimens of great beauty of iron so deposited. Examples of mediæval art of extreme intricacy may be faithfully re-produced; the tone of the metal being well adapted for a purpose of such interest.

In addition to the above, there were many stereotypes. Examples of the process of heliography were illustrated by impressions taken from electro-deposited iron plates. To this process the form of metal is singularly applicable.

The patent rights have been secured; and the extreme importance of the process in a commercial point of view cannot be too strongly insisted upon.

In conclusion, we may mention the result of some curious experiments given by Dr. Jacobi.

A rod of wax was first coated with a thin film of copper, and on this the iron was deposited. The rod was surrounded by a helix of copper wire, through which a current of electricity was passed. The deposit of iron produced was magnetic, and the metal was deposited in fine fibres at the poles, the tube being of a fine, close texture. The fine particles of iron followed the lines of the magnetic curve.

It may also be stated that the electro-deposited iron possesses the power of occluding twenty times its volume of hydrogen gas. Dr. Jacobi stated that further experiments were necessary to confirm this.

ON A

REMARKABLE STRUCTURAL APPEARANCE IN PHOSPHORUS.*

BY CHARLES TOMLINSON, F.R.S., F.C.S.

The following remarkable appearance in phosphorus was described to me some months ago by Mr. James John Field, F.C.S., who requested me, if possible, to account for it:—

About four years ago, Mr. Field placed about half a dozen sticks of phosphorus in a cylindrical jar containing water, which rose about ½ an inch above the ends of the sticks, and the jar was closed with a bung. This jar was placed in a cellar, where it remained undisturbed for about three years. The cellar is flagged with stone, is surrounded by damp walls, and almost entirely protected from light and currents of air. The maximum temperature probably did not exceed 50° or 55° Fahr.

After this long repose, the jar was taken into the laboratory, when it was found that the level of the water had sunk to about one-third of its original height, and the liquid left in the jar had become as dense and thick as the strongest syrup; it consisted of a solution of PO_3 and PO_5.

The portions of phosphorus that rose some inches above the liquid, instead of being cylindrical as before, were conical, from a sharp point to the full diameter, and each cone had a double spiral running down from left to right, as if two flat tapering bands of the substance had been made to cohere at right angles lengthwise, and then twisted into pointed rods, or just as if the sticks had been mounted in a screw-cutting lathe, geared to cut a coarse, tapering double spiral. The sticks had also changed from the creamy, opaque surface to a translucent, barley-sugar appearance, from the surface of the liquid up to the points.

In attempting to explain the appearances described, we must consider—*first*, the wasting away of the sticks, and their conical form; and, *secondly*, the twisted structure.

First. The wasting away of the sticks, and their

* Read before the British Association, Exeter meeting, Section B.

conical form, are clearly effects of slow combustion, diminishing in intensity downwards. The continued combustion, and also the evaporation of the water, must have been due to a badly-fitting cork, which, during a falling barometer, allowed a portion of the moist air to escape from the jar, and, during a raising barometer, allowed a portion of comparatively dry air to stream in. Had the jar been subject to considerable variations in atmospheric temperature, the effects would have been more rapid; but, as the temperature of the cellar was pretty constant, there is nothing to detain us here. Going back, then, to variations in atmospheric pressure, the level of the water in the jar would be gradually lowered during the oscillations of the barometer, until at length the tops of the sticks of phosphorus became exposed. Slow combustion would then set in; the resulting acid would go into solution, and small quantities of fresh air would stream in to supply the partial vacuum, and so continuet he action. During a falling barometer, nitrogen and moisture would stream out of the jar, the level of the water would be again slightly lowered, and a fresh portion of phosphorus be exposed to the attack of the next portion of oxygen drawn in. In this way, by very slow degrees, the liquid would be lowered, and fresh portions of phosphorus exposed. Those already out of the water would be attacked by every ingress of air, and, thus being acted on, not only more energetically, but also for a longer time, than the lower portions, they would necessarily have a conical shape. Moreover, the air that streamed into the jar would gradually lose its oxygen in descending, so that the lower portions would be acted on less strongly than the upper. The phosphoric acid, as generated, would also pass into solution with a certain rise of temperature, and a certain expansion of the nitrogen left in the jar. As this cooled down, a little more air would be drawn in, and combustion and solution would go on as before. But the most energetic action would be made when, under a falling barometer, a quantity of moist nitrogen streamed out of the jar; and, during a rising barometer, a fresh supply of atmospheric air streamed in, as already explained.

Secondly. As to the spiral markings: these cannot have been formed by any action that took place in the jar; but they show, I think, the new and interesting fact that the curves which the theory of hydraulics assigns to liquids flowing from an orifice, and producing the *vena contracta*, actually form part of the structure of a body suddenly arrested in its flow by being made solid.

It is well known that, in the ordinary manufacture, phosphorus is formed into sticks by being made to flow from a *head* or reservoir of the molten element along a short pipe or *ajoutage* into cold water—or, rather, as soon as the stick of phosphorus begins to emerge from the warm *ajoutage*, and shows itself in the cold bath, it is seized by hand, and cut off at intervals, or drawn out by machinery into a continuous length, so that from 15 to 20 lbs. and upwards of phosphorus can be moulded in less than a quarter of an hour.

Now of course in the flow of the molten phosphorus Torricelli's theorem applies—viz., that particles of a fluid, on escaping from an orifice, possess the same velocity as if they had fallen freely *in vacuo* from a height equal to that of the fluid surface above the centre of the orifice. If the head of phosphorus were not too deep, there would be seen immediately over the orifice a hollow depression, which increases until it becomes a cone, or funnel, the centre or lowest point of which is in the orifice, and the liquid flows in lines directed towards the centre. In this condition of the liquid, a rotatory motion is necessarily imparted to it, and this rapidly increases, because all the particles are approaching the centre, and, by virtue of their inertia, they tend to maintain the same velocity which they had in a larger circle, so that their angular velocity (or the number of revolutions in a given time) is constantly being increased. As the particles approach the orifice, they converge to a point beyond it, so that the liquid in escaping is narrower or more contracted at the point to which it converges, than it is either before it arrives at that point or after it has passed it. But, as this point in the phosphorus to which the rotatory lines converge, though fixed in or near the tube, is being constantly shifted in the phosphorus by being drawn out and moulded in the tube, the converging lines, also, are drawn out, and thus give the appearance of a double spiral. Of course, some of the lines are obliterated by the moulding action of the tube, and are probably of a different texture as to hardness as compared with the drawn-out lines. These flattened or moulded portions first yield to the action of slow combustion, and leave the harder drawn-out lines in relief.

ON THE

MEASUREMENT OF GASES AS A BRANCH OF VOLUMETRIC ANALYSIS.*

BY W. J. RUSSELL, PH.D.

LECTURER ON CHEMISTRY AT ST. MARY'S HOSPITAL MEDICAL SCHOOL.

At present, the measurement of the amount of gas given off during a reaction has been but little, if at all, used as a means of quantitative analysis. This has arisen from the want of some simple and easy way of collecting the gas evolved. In a paper read before the Chemical Society last year, I showed how carbonates might, with very considerable accuracy, be estimated in this way; and, since then, I have used the same method for determining the atomic weights of nickel and cobalt. This form of volumetric analysis is of more general application than might at first sight appear probable, and will, it is believed, in certain cases, be found of considerable importance. Having no standard solutions to prepare and keep in order is an obvious advantage; the gas apparatus, once in order, is then always ready for any kind of analysis in which gas is evolved; the reactions made use of, as a rule, take place rapidly; and the volume of gas, as far as the measurement of it is concerned, can be effected with very considerable accuracy. The amount of material used is generally very small, and the whole analysis occupies but a very short time, and can be very easily performed.

The form of apparatus used for collecting and measuring the gas has been already described in the *Journal of the Chemical Society* for August of last year. The following analyses, which have been made by this process, may be of interest as illustrations of the method:—

When carbonic acid is the gas evolved, it is obviously necessary to have as small a quantity of liquid present as possible, to prevent loss by absorption. A specimen of calc spar, which, theoretically, should contain 44·00 per cent of CO_2, gave, when dissolved in a mixture of two parts of nitric acid and one part of water:—

* Read before the British Association, Exeter meeting, Section B.

1st experiment,	43·93	per cent	of	CO_2.
2nd "	43·92	"	"	
3rd "	43·90	"	"	
4th "	43·97	"	"	
5th "	43·89	"	"	

Another specimen, dissolved in two parts of hydrochloric acid and one part of water, gave:—

1st experiment,	43·89	per cent	of	CO_2.
2nd "	43·90	"	"	
3rd "	43·90	"	"	
4th "	43·84	"	"	
5th "	43·90	"	"	
6th "	43·85	"	"	

In all these experiments, 1·2 c.c. of the dilute acid were used.

Some pure sodic carbonate, dissolved in 1·3 c.c. of two parts of water and one part of hydric sulphate, gave 41·48, 41·52, and 41·50 per cent. of CO_2. Theoretically, 41·51 per cent. should have been obtained.

An experiment with hydric chloride, instead of hydric sulphate, gave 41·52.

The strength of any acid is easily estimated by simply reversing this process, that is, taking a known weight of the acid and an excess of carbonate.

The reaction which takes place when manganic peroxide is heated with sodic oxalate and hydric sulphate, serves for the estimation of the amount of manganic peroxide present, every atom of oxygen liberated corresponding to two atoms of carbonic acid. A specimen of manganese gave—

1st experiment,	58·16	per cent.	of	MnO_2.
2nd "	58·10	"	"	

A specimen of potassic permanganate, dried at 100°, gave the following results (100 parts of permanganate yield 139·24 of CO_2):—

1st expt. found	136·70,	corresponds to	98·17	p.c.	$K_2Mn_2O_8$.
2nd "	136·00	"	97·69	"	"
3rd "	136·63	"	98·13	"	"

Potassic bichromate is another salt which can be easily analysed in the same way, by heating with the sodic oxalate.

Potassic bichromate yields 89·49 per cent of CO_2; a specimen of the salt gave—

1st expt.,	88·48	p.c. CO_2,	corresponds to	98·87 $K_2Cr_2O_7$.
2nd "	88·57	"	"	98·97 "

The same specimen, more strongly dried, gave—

1st expt., 88·62 p.c. CO_2, corresponds to 99·03 $K_2Cr_2O_7$.

Interesting and important results may be obtained by dissolving metals in acids, and measuring the volume of hydrogen evolved. A specimen of zinc dissolved in dilute hydric chloride gave—

1st expt.,	3·053	p.c. H,	corresponds to	99·22	p.c. zinc.
2nd "	3·051	"	"	99·16	"
3rd "	3·050	"	"	99·13	"

A specimen of electro-deposited zinc, which had been subsequently fused, given to me by Mr. Walenn, gave—

1st expt.,	3·060	p.c. H,	corresponds to	99·45	p.c. zinc.
2nd "	3·054	"	"	99·26	"

Another specimen of electro-deposited zinc gave—

1st expt.,	3·032	p.c. H,	corresponds to	98·55	p.c. zinc.
2nd "	3·033	"	"	98·57	"
3rd "	3·033	"	"	98·57	"

0·1832 grm. of the commercial powdered zinc was dissolved; it gave a volume of hydrogen corresponding to only 81·98 p.c. of metallic zinc. A specimen of what is sold as pure powdered zinc gave hydrogen corresponding to only 69·22 per cent. of zinc.

With nickel and cobalt, the same process is applicable, and has been used for determining their atomic weights. The results have been communicated to the Chemical Society, and will be published in the *Journal* of the Society.*

The following results have been obtained with different specimens of iron:—

Dr. Matthiessen gave me what he believed to be a specimen of pure iron; it gave—

1st expt.,	3·571	p.c. H,	corresponds to	100·00	p.c. iron.
2nd "	3·568	"	"	99·93	"

Steel piano-wire (No. 10) gave—

1st expt.,	3·444	p.c. H,	corresponds to	96·45	p.c. iron.
2nd "	3·445	"	"	96·49	"

Some of the same wire was dissolved, and the amount of iron estimated by Penny's process.

1st expt. gave	97·8	p.c. iron.
2nd "	98·2	"

Mean.

Hydrogen process, 96·47. Penny's process, 98·00

This gives a suppression of hydrogen corresponding to 1·53 per cent. of iron.

Cast-iron filings gave—

1st expt.,	3·375	p.c. H,	corresponding to	94·50	p.c. iron.
2nd "	3·366	"	"	94·27	"

When tested by Penny's process, the filings were found to contain 97·0 per cent. of iron; this gives a suppression of hydrogen corresponding to 2·62 per cent. of iron.

A specimen of gray crystalline pig-iron gave, when dissolved, a volume of hydrogen corresponding to only 89·04 per cent. of iron.

A piece of magnesium ribbon evolved an amount of hydrogen corresponding to 99·18 per cent. of metal.

The foregoing results will serve simply to indicate the kind of results which have been obtained by this form of volumetric analysis.

ON JARGONIA.†

BY H. C. SORBY, F.R.S.

I HEREWITH send, for exhibition at the Chemical Section, what I believe to be nearly pure zirconia, and jargonia prepared by a modified combination of the methods described by Mr. David Forbes and myself. You will notice, at once, that the zirconia is perfectly white, whereas the jargonia is of a clear straw-colour. This exactly corresponds with the difference between the opaque borax blowpipe-beads heated to redness, as described in my paper in the *Proceedings of the Royal Society*, and I am strongly inclined to believe that it is a characteristic peculiarity. At first I thought it might be due to the presence of a small quantity of iron, since zirconia, containing a little of the peroxide, is of a similar yellow colour. When, however, that is digested in sulphide of ammonium, it quickly turns to a deep green

* See Chemical News, vol. xx., p. 20. *Am. Repr., Sept.*, 1869, *page* 158.

† Extract from a letter to Mr. Crookes, read before the Chemical Section of the British Association, Exeter meeting.

colour; whereas this yellow jargonia does not turn at all green. Subsequent experiments may show that the colour is due to some other substance; but, taking all the facts now known into consideration, it seems extremely probable that, after ignition, jargonia is of a clear straw-colour, paler than that of tungstic acid, but deeper than that of ceroso-ceric oxide.

The following is a complete list of the papers which were brought before Section B (Chemical Science) at the Exeter Meeting:—

Herbert McLeod.—*Report on the Determination of the Gases Existing in Solution in Well Waters.*

A. Matthiessen.—*Report of the Committee on the Chemical Nature of Cast-Iron.*

M. Jacobi.—*On Electrolytic Iron.*

J. Moffat.—*On the Phosphorescence of the Sea and Ozone in Connection with Atmospheric Conditions.*

J. Moffat.—*On the Oxidation of Phosphorus and the quantity of Phosphoric Acid Excreted by the Kidneys in Connection with Atmospheric Conditions.*

C. Tomlinson.—*On a Remarkable Structural Appearance in Phosphorus.*

B. H. Paul.—*Report on Treatment and Utilisation of Sewage.*

F. Braby.—*On Extraction of Ammonia from Gas Liquor.*

Stevenson Macadam.—*On the Economic Distillation of Gas from Cannel Coal.*

Walter Weldon.—*On the Manufacture of Chlorine by means of Perpetually Regenerated Manganite of Calcium.*

T. L. Phipson.—*On some New Substances Extracted from the Walnut.*

T. L. Phipson.—*On the Solubility of Lead and Copper in Pure and Impure Water.*

W. J. Russell.—*On the Measurement of Gases as a Branch of Volumetric Analysis.*

C. Tomlinson.—*On the supposed Action of Light on Combustion.*

Crace Calvert.—*On the Amount of Soluble and Insoluble Phosphates in Wheat Seed.*

H. Sorby.—*On Jargonia.*

S. Williams.—*On the Action of Phosphoric-chloride on Hydric-Sulphate.*

J. Dewar and G. Cranston.—*On Some Reactions of Chloro-Sulphuric Acid.*

A. Matthiessen and C. R. A. Wright.—*On the Action of Hydrochloric Acid on Morphia and Codeia.*

T. Andrews.—*On the Absorption Bands of Bile.*

M. Janssen.—*Methode Spectrale pour la recherche des Composés du Sodium.*

M. Janssen.—*Sur le Spectre de la Vapeur d'Eau.*

W. C. Roberts.—*On a specimen of Obsidian from Java.*

W. D. Michell.—*Are Flint Instruments of the First Stone Age Found in the Drift?*

E. C. C. Stanford.—*A Chemical Method of Treating the Excreta of Towns.*

H. Bamber.—*On the Water Supplies to Plymouth, Devonport, and Exeter.*

P. Spence.—*On the Production of Higher Temperatures by Steam of 212° Fahrenheit.*

A. Oppenheim.—*On Bromo-iodide of Mercury.*

A. Oppenheim.—*On Benzoe-sulphuric Acid.*

Professor Jellett.—*On a Method of Determining with Accuracy the Ratio of the Rotating Powers of Cane Sugar and Inverted Sugar.*

Dr. Fritsche.—*Notes on Structural Change in Block Tin.*—Communicated by W. C. Roberts.

H. Cooke.—*On the Registration of Atmospheric Ozone in the Bombay Presidency, and the Chief Causes which Influence its Appreciable Amount in the Atmosphere.*

J. Lowthian Bell.—*On the Decomposition of Carbonic Oxide by Spongy Iron.*

Report of the Committee for Recommending Increased Facilities for Scientific Investigations.—The following is the report of the "Committee for Recommending Increased Facilities for Scientific Investigations:"—Your committee, having sought the council of many of the most eminent men of science of the United Kingdom upon these questions, so far as it was found practicable to do so, and having carefully deliberated thereon, have arrived at the following conclusions:—I. That the provision now existing in the United Kingdom of Great Britain and Ireland is far from sufficient for the vigorous prosecution of physical research. II. It is universally admitted that scientific investigation is productive of enormous advantages to the community at large; but these advantages cannot be duly reaped without largely extending and systematising physical research. Though of opinion that greatly increased facilities are undoubtedly required, your committee do not consider it expedient that they should attempt to define categorically how these facilities should be provided for the following reason:—Any scheme of scientific extension should be based on a full and accurate knowledge of the amount of aid now given to science, of the sources from which that aid is derived, and of the functions performed by individuals and institutions receiving such aid. Your committee have found it impossible, with the means and powers at their command, to acquire this knowledge. A formal inquiry, including the inspection of records to which your committee have not access, and the examination of witnesses whom they are not empowered to summon, alone can elicit the information that is required, and, as the whole question of the relation of the state to science, at present in a very unsettled and unsatisfactory position, is involved, they urge that a royal commission alone is competent to deal with the subject. Your committee hold that this inquiry is of a character sufficiently important to the nation, and sufficiently wide in its scope, to demand the use of the most ample and most powerful machinery that can be brought to bear upon it. Your committee therefore submit, as the substance of their report, the recommendation that the full influence of the British Association for the Advancement of Science should at once be exerted to obtain the appointment of a royal commission, to consider—(1). The character and value of existing institutions and facilities for scientific investigation, and the amount of time and money devoted to such purposes. (2). What modifications or augmentations of the means and facilities that are at present available for the maintenance and extension of science are requisite; and (3). In what manner these can be best supplied.

Place of Meeting for Next Year.—At the meeting of the General Committee, on Monday last, it was decided that the meeting next year should be held in Liverpool, under the presidency of Professor Huxley, F.R.S., &c.

[English Edition, Vol. XX., No. 509, pages 104, 105.]

NOTICES OF BOOKS.

What is Matter? By an Inner Templar, Author of "More Light: a Dream in Science."

We are informed by his biographers that when the author of "The Raven" composed his extraordinary lecture on Cosmogony, he started by denying that the arcana of the universe can be explored by induction. He informed his imagination with the various results of science, and then "entered with unhesitating boldness, though with no guide but the divinest instinct, into the sea of speculation, and there built up of according laws and their phenomena, as under the influence of a scientific inspiration, his theory of nature."

But Poe, although a poet, was, in his lucid intervals, well aware of the difference between poetical speculation and hard scientific truth, and, with characteristic audacity and clearsightedness, dedicated his work "To those who feel, rather than to those who think." Poe's work was in perfect logical harmony with the rules he laid down for himself as a poet, and we therefore accept it. The work before us is in logical harmony with no laws human or divine, and we therefore reject it. When a man writes nonsense and, by publishing it, challenges criticism, it is our duty to consider whether, "though it be madness, there is method in it;" and we are forced to admit that there is method in the work before us—but not much.

When a man writes nonsense, we are also bound to consider the tone in which he writes it. If he offers us his views on the more difficult problems of the universe, and those views are obviously incorrect, still, if propounded modestly, and argued cleverly, we receive them for what they are worth, and are loth to handle their author too roughly. But the views of the author of "What is Matter?" are neither propounded modestly, nor argued cleverly, and we therefore do not feel bound to be specially lenient to him.

Doubtless the Inner Templar considers that to fairly review his book, we should analyse each chapter *seriatim* and disprove his arguments as they arise; this, however, is impossible. A long review of such a work would not only be unreadable but utterly useless, and we think that if we convict our author of want of modesty, of want of judgment, and of ignorance of the subject on which he writes, we have done as much as can be expected under the circumstances.

When a man feels that those problems which have puzzled the wisest of mankind are to him easy of solution, we can forgive him for being (for a short time) so elated as to be moved by a crowd of foolish impulses, and if, in addition, he finds that all physical phenomena, including the secret of the nature of matter, are to him as self-evident things, we can forgive him for believing himself the wisest of mankind. But, on the other hand, if we find him announcing almost incredible discoveries, as revelations from an angel, and describing the revealer and the manner of the revelation in language of that childishly pompous character which our American friends stigmatise as "high falutin," we begin to doubt whether such absolute want of judgment can co-exist with superhuman clearsightedness.

The first announcement of the work before us was contained in a pamphlet called "More Light," which we noticed a few weeks ago, and we feel bound, after again looking at it, to say that it was one of the silliest productions ever written; and yet *The Tablet* (we quote from the opinions of the press) considers itself bound to "do the writer the justice to say, that his brief narrative is pleasantly written, and constitutes a lively contribution to a class of works rarely attractive to any but scientific readers." We feel bound to do the writer of the notice in the *Tablet* the justice to say that the only redeeming point in his notice is the fact that he offers "no opinion as to the scientific value of this little treatise." In fact, it is most unpleasantly written, and constitutes anything but a lively contribution to a class of works rarely attractive to any readers whatever.

"What is Matter?" is a neat little octavo volume of 195 pages. It is excellently printed on good paper, and all rights are reserved.

The work is divided into three books, each of which is subdivided into chapters, and there is a very complete table of contents.

The first book is principally devoted to a sketch of the opinions of the principal philosophers of antiquity, and we need not say that the continual repetition of such names as Thales, Anaximenes, Diogenes, Heraclitus, Anaxagoras, Zenophanes, Pythagoras, Empedocles, Leucippus, Socrates, Plato, Aristotle, Epicurus, Zeno, &c., &c., gives an air of dignity to the work which we hasten to acknowledge.

In Chapter VII. we come to a discussion on the views of Faraday, and Dr. Daubeny is severely handled for deficiency of imagination, and prejudice, and we are told that "It is painful to notice how he clings to existing notions, and appeals to common sense." We shall show further on that the last mentioned fault of the lamented Professor is one which can never be justly urged against our Inner Templar. Our author is not nearly so dogmatic upon some of the questions he discusses as might be expected from the favoured pupil of Oriel (see "More Light" *passim.*) In examining the question as to whether interplanetary space is on vacuum or a plenum, Sir John Herschel is quoted as of opinion that the sun is in a continually excited electrical state, which may account for the tails of comets being always directed away from the sun. "But" says our author, "this loses a great deal of its force, as that which produces the plenum is ether; but when a vacuum is produced by experiment, it is always supposed that the vacuum is a plenum so far as the ether is concerned, for no pump has ever been constructed which touched that point, and, in fact, if the vacuum be not a plenum of ether, what becomes of the undulatory theory, for light passes through a vacuum, as is very clear, or we should not be able to see a light on the other side of the receiver, and it must on that theory have ether to be set in vibration. And if we suppose the vacuum to be a plenum of ether when the air is removed, we have had two plena occupying the same space, which, surely, is not orthodox; and if it be argued that the ether was hidden in the pores of the air, how is it that this ether continued to stay behind when the air was driven out? If, then, every vacuum must be a plenum of ether, as the undulatory theory requires, and electricity will not pass through such a vacuum; it seems clear that light and electricity differ greatly, for it appears that electricity requires *ordinary* matter for its medium, but light not. May not, then, electricity be regarded as a sublimating of ordinary matter, and light such matter sublimated? for electricity produces light, but it does not appear that light must necessarily produce electricity. Altogether, what with plena, and vacua, and ether, the subject is in as highly organised a state of confusion as the bitterest opponent of the undulatory theory could wish for."

We have made this long quotation solely that it may not be said that we have condemned a book without sufficient reason. Is it too much to say that the "highly organized confusion" is in the bewildered brain of the Inner Templar? The query as to whether electricity may not be regarded as a sublimating of ordinary matter, and light as such matter sublimated is charming, and will, we trust, be put to "Oriel" at his next meeting with our author.

We must, absolutely, make one more quotation. Our author, speaking of a ray of light proceeding from the sun, says, "Such a ray, I conceive, consists of a continuous stream of atoms travelling with different velocities, and at the same time revolving with different velocities upon axes at right angles to their line of projection. These particles are but ultimate atoms of the different forms of matter existing in our solar system, and, though so minute as to be beyond all power of weight, have, I doubt not, a considerable influence in renewing the energy which is being continually expended by our globe. This incessant pouring of millions upon millions of ultimate particles of the elements into our atmosphere, and into even the solid body of the earth, must, I think,

greatly assist in explaining not only the almost universal presence of sodium—doubtless the chief cause of the yellow rays of the sun—but the presence of many other forms of matter which exist to such an extent in the atmosphere that it has been remarked that, in a cubic yard of air, might be traced the presence of almost every elementary substance. And, again, in regard to the ocean, which occupies three-fourths of the surface of our globe, who can say that the floods of light poured into its depths ages ago, when the sun's power must have been much greater, not to mention its present influence, may not have had a great effect upon its constitution—we know how its temperature is affected—and greatly contributed to the presence of those metals—especially sodium—which are a part of its constitution?" When we remember that, in "More Light," our author distinctly asserts the original matter to be nothing revolving upon an axis, that he also, in this work, states that he regards light to consist of the ultimate atoms revolving upon axes, and that these atoms are beyond the power of weight because they are so small, and that the sodium in the sea is derived from the sun's rays, we think we have proved to every reasonable person that our author is devoid of judgment in general, and that he is ignorant of the subject upon which he writes. As regards his modesty, let us quote one more paragraph from the author's "conclusion." "I have not hesitated to take the heterogeneous mass of materials supplied by every eminent man from Thales to Kant, and out of it to construct an edifice which, harmonising in all its parts, will, I trust, defy all the insidious workings of time with all the power that either talent can produce or ingenuity afford; but it is to the labours of Snellius, Newton, Faraday, and other great workers in the scientific world, that I am chiefly indebted." We ask our readers if this is not without a parallel in scientific literature?

In conclusion, there is internal evidence in "More Light" and "What is Matter?" to show that the author is a very young man. He has read much, and is by no means devoid of enthusiasm and a certain kind of cleverness. He is, however, unfortunately utterly devoid of modesty, and will, therefore, not accept advice. If he would, he might even now, perhaps, become a useful labourer in the field of science. Let him, instead of making a childish boast of never having made a single experiment, let him, we say, take up a physical or chemical question and experiment upon it earnestly and faithfully, and his mind will become disciplined, and, possibly, in his maturer years he may even acquire modesty. If he wishes to learn a great truth, let him experiment upon a subject which he has made all his own. Let him take pure water and see if, by passing the sun's rays through it, he can condense the chloride of sodium; if so, it is evident that, by the aid of "more light," he will obtain sea water. When he has condensed enough salt to be detectable by the spectroscope we will revise our review, retract our strictures, and unreservedly follow the Inner Templar as our guide, philosopher, and friend!

Revue Scientifique et Industrielle. Par Emile Kopp, Professeur du Musée Royal et Industriel Italien à Turin. Extraits du *Courrier du Bas-Rhin.* Strasbourg: 1869.

In this work—in which, (as somebody says) there is a thin rivulet of text meandering through a broad meadow of margin—we find nine articles, three of which, on "*Le Blanchisseuse Domestique*" we cordially recommend to the notice of housewives in general, and of all foreign nations—especially Sicily—in particular. Why M. Kopp has given this prominence to the subject we are at a loss to imagine unless he has fond recollections of *Blanchisseuses de fin*, and *Closerie de Lilas.* At all events, he has done good service, and shown an utter absence of pride by descending from the lofty heights of organic chemistry to the washing of linen; and what an astonishingly practical man he is! He treats of "*Inconvenients d'un trop riche Assortiment de Linge*," which, it must be confessed, few have discovered; he treats of *savonnage*, *rinçage*, *azurage*, *tordage*, and *sécharge.* We have found a frequent appeal to the dictionary necessary, and sometimes useless; let any of our readers tell us off-hand the English of *essangeage*: we had not the least idea that the French language was so rich in ablutory words, and we accept it as a happy omen. M. Kopp *must* become the hero of laundresses from his admirable ideas of economy; look here, for instance—"A la vérité le savon bien sec, surtout le bon savon de Marseille, se dissout bien moins rapidement, et on realise ainsi une économie notable." Will some *bon savant* tell us all about "le bon savon de Marseille?"

The other articles treat of the "Anomalous Properties of Water," of "Meteorites," of "Explosive and Fulminating Substances," of "Fire-Arms," of "Nitroglycerine," and of "Gun Cotton." They contain, for the most part, a good *resumé* of recent research in connection with each subject, and may be perused with advantage.

Exeter Change, for the British Lions. Edited by Snug the Joiner. London: B. Pardon and Son, Paternoster Row. 1869.

The British Association for the Advancement of Science meets this year, as all the world knows, at Exeter. Exeter Change, as all the world—specially the younger portion of it—does *not* know, was once one of the sights of London; for therein were housed the British Lions which had whilom dwelt in the Tower of London, and, symbolising the sovereignty of this realm, had been considered necessary appurtenances of Royalty. "Exeter Change," says the editor of the pamphlet before us, "has disappeared, and the ground hallowed by memories of the caged lions; and the solitary beadle is now occupied by the Gaiety Theatre. Need I add that my title-page is deeply significant. You British Lions have now an Exeter Change productive of gaiety."

"Exeter Change" is not a satire; it has nothing of the lampoon about it; the sarcastic Roman Pasquino would scarcely allow it to be called a pasquinade; there is nothing in it the least bitter or spiteful, nothing that smacks of the *Tomahawk*, or *Queen's Messenger.* The mention of an individual is generally accompanied by his laudation, or, if the reverse, the censure is no more than the most harmless "chaff." What, then, shall we call it? A parody? Scarcely. A squib? By no means. A burlesque? This is nearer the mark; particularly if we may trace the word through the Italian *burlesco*, and the Low Latin *burleschus*, to the classical *burra*, as Mr. Donald tells us; but Ainsworth is silent about *burra*, and approaches it no more nearly than *bura*, which signifies "the hinder part of a plough," and is scarcely appropriate. What, then, remains to us? A travesty? That will do better. "Exeter Change" is a sort of travesty; or, if the reader pleases, he may find in it just a *soupçon* of several of the above forms of composition.

Having defined our work, let us look more closely into it. In the "Prologue," the editor greets the various presidents of sections and learned bodies of the British Association, and states the object and aim of his work. This is followed by a "History of the Association," written in the exact and somewhat prosaic style of certain students of the Buckle School. Then comes the "Wail of the Mathematician," a poem in imitation of "Locksley Hall," which is clever, and shall speak for itself—albeit in a somewhat *staccato* manner. The mathematician here describes the progress of his courtship:—

"Once about the beach we wandered, spooning in a way sublime,
While the dreary tales of Science were reserved for future time;

When geologists before us on contorted strata prosed,
We were sure to find a seaweed in a place not much exposed."

"At the time when Dr. Hooker the Darwinian standard raised;
At the time when sharp Miss Becker got herself unduly praised;

At the time when Father Secchi fraternised with prelates grave;
Then it was that I discovered I was simply Kitty's slave."

Determining to discard this fickle Kitty, the mathematician tries to find some strong-minded woman—

"Iron-visaged, tall, and skinny, she the bluest of the blues,
Shall with potent mathematics my domestic life suffuse.

Dingy black shall be her costume: pins shall take the place of hooks;
And her hair, close-cropped, shall startle followers of fashion books."

The poem is followed by a long article on "The Development Hypothesis," a travesty of some recent animadversions of the German anti-Darwinites. "On some Recent Spectral Observations" follows this. Herein a man is supposed to fall asleep in his library, and to see a vision of the various authors of the books around him, and to hold a short conversation with them: the following extract is taken from the concluding portions:—

"But there now arose such a clamour that I could not hear myself speak. Albertus Magnus *would* keep striking Avicenna with a crozier; Cardinal Bellarmine threw his hat at Galileo; Abelard tripped up William of Champeaux, the pretty little Heloise flirted with Peter of Cluny; while a host of Plenists, headed by Father Linus, were having a set fight with a host of Vacuists, headed by Robert Boyle."

Next we have "Mercurius Rex"—a chemical ode. Recitative and air, with accompaniments of Maëlzel's metronome, contrabassos in F in altissimo, Helmholtz's double syren, and the tibia pastorale.

In the next article—"On the Alcoholic Compound termed Punch," by John T—nd—ll, LL.D., F.R.S.—we have a capital imitation of the style of a certain eminent lecturer and physicist. Let us content ourselves with the last two paragraphs—

"Experiment has proved that the juice of three or four lemons, and three-quarters of a pound of loaf sugar dissolved in about three pints of boiling water, give saporous waves which strike the palate at such intervals that the thrilling acidity of the lemon-juice and the cloying sweetness of the sugar are no longer distinguishable. We have, in fact, a harmony of saporific notes. The pitch, however, is too low, and to heighten it, we infuse in the boiling water the fragrant yellow rind of one lemon. Here we might pause, if the soul of man craved no higher result than lemonade. But to obtain the culminating saporosity of punch, we must dash into the bowl, at least, a pint of rum and nearly the same volume of brandy. The molecules of alcohol, sugar, and citric acid collide, and an entirely new series of vibrations are produced—tremors to which the dullest palate is attuned.

"In Punch, then, we have rhythm within rhythm, and all that philosophy can do is to take kindly to its subtle harmonies. It will depend in some measure upon previous habits, whether the punch when mixed will be taken in excess or in moderation. It may become a dangerous ally of gravity and bring a sentient being to the gutter. But, on the other hand, it may become the potent inner stimulus of a noble outward life."

The remainder of the pamphlet is filled with shorter articles:—An "Alphabet for Young Associates;" "Rejected Addresses," giving a list of certain supposititious papers rejected by different Sections;" Advice "To the Dyspeptic Members of the Association," containing a *menu* in which we notice "Goujon sauté en l'eau froide;" "Poulet pansu;" "Porc à la trichine;" "Xéres de Hamburg nouveau et brûlant;" and "Vin d'Oporto des environs de Spitalfields."

"Eozöon Canadense: a lay of Chivalry from Section C" is a poem of twenty-one stanzas; "What will they do with it?" an account of a meeting in the Albert Hall of Arts and Sciences" in 1872, when a grand difficulty has arisen as to what use the Hall shall be applied to, and various *savants* express their various opinions. Then we have a letter from Francis Bacon, headed "Elysian Fields, August 15th, 1869," in which, in the quaint English of the early part of the seventeenth century, Bacon refers to his treatise "Nova Atlantis," and shows that he therein shadowed forth such an Association of the learned as we now have in the British Association for the Advancement of Science.

Altogether, "Exeter Change" is very readable. There is not much wit in it, but it is pleasant and lively, and never gross or coarse, nor do we detect any *doubles entendres*, too often the vehicle for raillery and sarcasm, and sometimes for what is worse. It is evidently the work of young writers; and it is equally evident that the matter has been struck off rapidly, without much elaboration, and this we consider an advantage, for, by the means, we get fresh, budding ideas, in the place of garish and dressed-up piracies. We wish Snug the Joiner, and his colleagues, Peter Quince and Nick Bottom, every success; and we commend their trim little work, not alone to members of the Association, but to their scientific *confréres* who have not journeyed to Exeter.

CORRESPONDENCE.

Royal Sulphur Spring, Harrogate.

To the Editor of the Chemical News.

Sir,—In my communication on the above spring, published in your valuable journal of the 16th of July (Chemical News, vol. xx., p. 26; *Am. Repr., Sept.*, 1869, *page* 140), by some mishap I omitted the analysis; it is appended:—

Saline Ingredients in the Imperial Gallon.

	Grains.
Carbonate of lime	18·649
Carbonate of magnesia	1·783
Carbonate of baryta	0·291
Carbonate of strontia	trace
Chloride of sodium	538·180
Chloride of potassium	3·103
Chloride of calcium	32·327
Chloride of magnesium	27·872
Chloride of barium	0·494
Chloride of strontium	trace
Chloride of lithium	faint trace
Sulphide of sodium	9·135
Iodides, bromides, &c.	traces
Total grains per gallon	631·834

—I am, &c.,

Sheridan Muspratt, M.D.

College of Chemistry, Liverpool,
July 26, 1869.

Oleographs.

To the Editor of the Chemical News.

Sir,—Having been from town, I have only to-day seen the Chemical News, and I beg you will allow me to reply briefly to Mr. Tomlinson's letter in reference to oleographs. Like every other new and valuable discovery, oleography is praised, and by others condemned. Oleography is yet in its infancy, and, just as a new and perfect process for the ultimate analysis of a complex organic substance cannot be devised in—it may be years, so we cannot expect perfection at once in this beautiful method for testing oils. I can assure Mr. Tomlinson that it is no fault of mine that he is pestered with numerous paragraphs from all varieties of journals commending oleography. I never sent any article to one of them but the Chemical News on the subject, nor have I seen them. My opinion is yet the same that oleography is, in its present and very much improved state, an excellent conjunctive test for the purity of oils. No one can doubt for a moment, who has really worked at the subject carefully, that an oil figure on water can be transferred in an instant, perfectly uninjured, to paper. In the examination of trade oils, besides using oleography to assist me, I also employ the following among other tests:—

Appearance, gravity, taste, odour, rate of passage through narrow tubes, weak and strong solutions of potassic, sodic, and ammonic hydrates; shaking the oil, rise in temperature with hydric sulphate, boiling in alcohol, boiling point, burning in lamp, freezing point, passing chlorine, calcic hydrate, euchlorine, calcic hypochlorite, mercurous nitrate, hydric phosphate.

I trust Mr. Tomlinson is satisfied that I have no desire to associate his name with oleography further than to acknowledge that his name is intimately connected with cohesion figures. At many lectures I have given, here and elsewhere, in which I introduced oleography, I always took care to mention Mr. Tomlinson's name while referring to cohesion figures only. I perfectly agree with him in not wishing to describe oleography as having arrived at perfection. It is quite a young art yet; it has fulfilled all I have said, and it promises greater things.—I am, &c.,

R. Carter Moffat.

Laboratory, Glasgow Mechanics' Institution,
August, 4th, 1869.

MISCELLANEOUS.

Hallogenin.—Under this name is sold in Germany a mixture of salts intended to prevent the formation of incrustations in steam-boilers. The mixture consists of 65 per cent of sal-ammoniac, 17 per cent of chloride of barium, and 18 per cent of catechu; it is said to answer its purpose very well.—*Deutsche Ind. Zeitung.*

Removal of Nitrate of Silver Stains from Woven Tissues.—According to M. Grimm, chloride of copper completely removes, even from coloured woven cotton tissues, stains occasioned by nitrate of silver; the tissue is to be afterwards washed with a solution of hyposulphite of soda, and next thoroughly washed with water. From white cotton and linen tissues, nitrate of silver stains are more readily and effectively removed by applying dilute solutions of permanganate of potassa and hydrochloric acid, followed by washing with hyposulphite of soda solution, and rinsing in plenty of fresh water. By these means the use of the highly poisonous cyanide of potassium is rendered unnecessary.—*Polyt. Notizblatt.*

Protection of Wood from Fire.—We learn from the *Deutsche Industrie Zeitung* of July 1, that at one of the collieries at Ibbenbüren, Westphalia, the woodwork is protected from fire by being painted with a mixture consisting of 5 parts of alum, 7 parts of rye-meal paste, and 30 parts of previously washed, *i.e.*, finely divided, clay (this mixture is used for woodwork not exposed to open air); for woodwork, so exposed, a mixture is used consisting of 2½ parts of crystallised sal-ammoniac, 1 part of white vitriol (commercial sulphate of zinc), 2 parts of joiners' glue, 20 parts of zinc-white, and 30 parts of water. These mixtures have been found to prevent wood bursting into flame on ignition, and to greatly delay its destruction even when severe fires are raging.

Thermoscope for Lecture Rooms.—Dr. A. W. Hofmann states that he frequently makes use of the following arrangement for the purpose of exhibiting, in a ready manner, the evolution of heat which takes place in chemical combinations and decompositions.—Some ether is poured into a tall test tube, and this tube is placed, for instance, in a recently-made mixture of sulphuric acid and water, the ether begins to boil, and its vapour may be ignited; in order to regulate the boiling of the ether it is best to place in it a platinum wire spiral. When, in a beaker glass, some sulphuric acid is first poured, and next, carefully on the top thereof, a layer of water, and these fluids are suddenly mixed by stirring the same with the ether tube, a flame of half a metre length may be suddenly evolved from the tube. The author has frequently applied this contrivance to exhibit the disengagement of heat on the sudden solidification of saturated solution of acetate of soda.—*Berichte der Deutsche Chem. Ges. zu Berlin.*

[This device was frequently adopted by Faraday during his Christmas Lectures.—*Ed.* C.N.]

Application of Leichtenberg's Experiment to the Mineralogical Analysis of Rocks.—M. S. Meunier proposes to make use of the well-known experiment of Leichtenberg's electric figures to separate from each other the divers mineralogical constituents of some kinds of rock. We briefly remind our readers that the experiment alluded to consists in charging with electricity a cake of resin or sealing-wax, by means of a previously-charged Leyden jar; it is thus possible to charge certain portions of the cake with positive, others with negative, electricity. In order to exhibit this to sight it is usual to blow, by means of a small pair of bellows, on to the cake of resin, a mixture of very finely-powdered red lead and sulphur; the friction, on leaving the nozzle, causes the powders to become electrified, and the sulphur being negatively electric is attracted by the curved figures positively electric on the cake, while the red lead follows the opposite course. M. Meunier has tried thus to separate sulphur-bearing trachite into its mineral constituents, and succeeded perfectly in getting the sulphide and feldspar from each other; he states that he has equally well succeeded with rocks made up of two different silicates.—*Cosmos.*

Analysis of Polcura.—Under the name of polcura there has been lately brought from St. Jago de Chili a mineral, met with, at a height of from 12,000 to 14,000 feet above sea level, in the Cordilleras de los Andes, imbedded between porphyry and melaphyr; this mineral exhibits a dirty yellow-coloured grainy somewhat crystalline mass; is acid and astringent to the taste; heated to 120° C., it loses 13·560 per cent. of water, 24·184 per cent. of the substance is soluble in boiling water from the portion insoluble in that fluid, equal to 62·251 per cent., hydrochloric acid dissolves 12·351 per cent., while the remaining 49·900 per cent. is silica. The portion soluble in water yielded, on being quantitatively analysed, results as follows:—Sulphate of potassa, 2·5 per cent.; sulphate of soda, 2·7; sulphate of lime, 26·1; sulphate of magnesia, 16·1; sulphate of alumina, 40·2; persulphate of iron, 4·6; chloride of sodium, 0·4; and soluble silica, 7·4. The portion insoluble in water, 62·251 per cent., consists of the following substances:—Alumina, 2·007; peroxide of iron and trace of manganese, 6·700; sulphuric acid, 3·330; silica, 49·900; and water, 13·560. The polcura is applied, in the country where it is found, to the tawing of the skins of sheep, goats, and calves; from the composition of its constituents, soluble in water, it will be readily seen that it is eminently fit to serve this purpose.—*Dingl. Polyt. Journ.*

Bubbles of Mercury floating on Water.—When the lecture room of a chemical laboratory is provided with a sufficient supply of water under strong pressure, it is possible to make, and exhibit there, an experiment which, owing to a deficient pressure of water in such rooms, has been almost unnoticed. The experiment is the following:—Under an ordinary water-tap, the opening of which has from 10 to 12 m.m. diameter, a large-sized porcelain basin is placed, containing from 15 to 20 kilos. of mercury; the water-tap being suddenly opened, a strong flow of water is caused to fall into the basin at a height of from 8 to 10 centimetres from its bottom. On turning off the flow of water again, it will be seen that on the surface of that fluid there float about bubbles of mercury, usually exhibiting a diameter of only 1 centimetre, but occasionally some are found of two or three times that size. As a rule these bubbles are very ephemeral; now and then, however, it happens that some may be caught, along with a quantity of water, in a small beaker glass, and, on the mercurial bubbles bursting, it will be seen how very small a quantity of mercury these bubbles consist of. Professor Hofmann mentions that he saw this experiment first exhibited in the lecture room of the Royal College of Chemistry, London, when, some twenty years ago, Professor Melsens, rom Bruxelles, was on a visit there. The pressure of water

at the lecture room just named is from 10 to 12 metres; in the new laboratory of Berlin University the pressure of the water circulating in the tubes and pipes is from 20 to 25 metres.

University of London.—The following are lists of the candidates who have passed the recent examination in Arts and Science. *First B.Sc. Examination* (*Pass Examination*).—First Division. Edward Bibbins Aveling, University College; Walter W. Rouse Ball (First B.A.), University College; Henry Septimus Bott, Owens College; Frank Clowes, Royal College of Chemistry and Pr. st.: John William Elwes, King's College; Thomas Oliver Harding, B.A., University College; Marcus Manuel Hartog, University College; Charles William Hodson, Chester College; David Bridge Lees, B.A. Camb., Owens and Trinity College, Cambridge; Robert Routledge, Owens College. Second Division. Hampden Gurney Jameson, University College; Sidney Follett Osler, University College; Charles Rigg, Chester College; Robert Davies Roberts, University College.

The Metric System of Weights and Measures.—The second report of the Standards Commission has just been published, together with an appendix of detailed information. The Commissioners confine themselves in this report to the questions connected with the metric system, and with its adoption in the United Kingdom; and they consider the reasons for and against its introduction under two heads—namely, those which relate to the internal commercial transactions of the country; and those which relate to transactions with other countries. With regard to the former, they observe that there is at present no inconvenience arising from the discordance between the customary weights and measures, because, whatever difference may prevail as to the multiples in local use, the essential units—the yard, the pound, and the gallon—are everywhere the same; based upon standards which are constructed with the utmost skill and care, and supported by a system of inspection which, though chargeable with imperfections, is, on the whole, efficient. Moreover, the requirements of different trades need somewhat different bases. The yard is a very convenient length for draper's measures, but the foot is far more convenient for carpenter's measure. It has been remarked that the last, or coomb, the bushel, and the peck, are well suited for men's backs, arms, and hands; and also that the natural inclination of the mind to halve and quarter continually exhibits itself in the subdivision of almost every base. The metric system does not offer facilities either for the change of the adopted base, or for the continued binary subdivision; and any attempt to force it into use in shops and into workmen's operations and accounts would probably be felt as a needless grievance. At the same time the want of weights and measures, on a decimal scale generally, or on the metric scale specifically, is not unfrequently felt by the manufacturing and trading classes, and more especially by men of science and by chemists and engineers of the highest class; and it appears hardly possible to satisfy this want except by the legal establishment of metric standards, and by the legal sanction of the use of metric weights and measures in shops and offices of conveyance. In order to prevent confusion, it would be necessary to provide that the metric weights and measures should have such form or other characteristics as would render it impossible to mistake them for those of the existing system; and in a future report the Commissioners promise to deal with the question of further simplification by the abolition of troy weight. Passing on to our transactions with foreign countries, the Commissioners remark upon the recent great increase in the amount of these transactions, and argue from it to the permissive adoption of the system which agrees with that of so many of our foreign trade correspondents, as well as to the giving the ordinary statistical publications relating to trade on the metric as well as on the imperial system. Attention is next called to the degree in which the introduction of a decimal system of coinage would assist in rendering the public familiar with the use of decimal weights and measures; and the report concludes by recommendations arranged under nine heads. These recommendations are, in substance, that metric standards under the French nomenclature should be legalised and provided, but that the use of the system should be entirely permissive, and not even in prospect compulsory; that regulations should be adopted to prevent confusion between the two classes of weights and measures; that Customs and other duties might be levied and the business of public departments conducted by either system; that mural standards of both systems should be exhibited in public places; and that the decimalisation of our system of coinage should be undertaken by the Government. At the same time it appears to the Commissioners to be essential that any measure for the introduction of the metric system should be proposed to Parliament by the Executive Government; and, considering that the Commission will shortly enter upon the questions referred to, those relating to the system of local inspection of weights and measures throughout the United Kingdom, its members are of opinion that "it is expedient that no legislation should take place with respect to the metric system until the whole subject of the weights and measures of this kingdom be brought before Parliament in one bill."

To Melt Two Metallic Mixtures by Friction.—Melt, in one vessel, one part of mercury and two parts of bismuth; and in another one part of mercury and four of lead. When cold, they will be quite solid, but, by rubbing them against each other, they will soon melt, as if each had been rubbed separately against red-hot iron.—*American Artisan.*

Death of M. Leiber.—We regret to learn the sudden demise of M. Leiber, the founder of the *Moniteur de la Photographie*, and the *Encyclopédie Photographique*, one of the kindest and most intelligent of the scientific publishers of Paris. His establishment, the Librairie Centrale des Sciences, in the Rue de Seine, has, for the last fifteen or twenty years, been the daily resort of the most eminent men of science; and his extensive knowledge of the older chemical and physical opuscules (memoirs, papers, notes, reprints, &c.) published in France, Germany, England, and America, caused him to be frequently consulted by literary men and authors of scientific works. His loss will be keenly felt by a very large portion of the enlightened Parisian public. Among the foreign works issued by him in French, we may notice the excellent little treatise on "Electricity," by Sir William Snow Harris, and De Filippi's charming "Letters to my Daughter on Terrestrial Creation."

Molybdenum and Chromium.—These metals can, according to Loughlin, be easily prepared as follows:—A mixture of one part of pure molybdic acid and one and a half of cyanide of potassium is placed in a porcelain crucible, and the lid luted on; this is placed in a large crucible, and the interstices having been packed with animal charcoal, the entire arrangement is exposed to a strong white heat for twelve hours; when cold the inner crucible is found lined with a white silver-like metal not acted upon by hydrochloric acid, but readily dissolved by nitric acid, and having a specific gravity of 8·56. By substituting oxide of chromium for molybdic acid metallic chromium is obtained.—*Engineer.*

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of every chemical paper in the world, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional*

advantage of keeping the readers on a level with the latest advances of science.

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Manufacture of Chocolate.—M. Tresca.—Although this matter appears very heterogeneous, and even trivial, we must not neglect to say a few words on this subject, taken from the ably-written report made by the gentleman just named, on the chocolate mills and factory belonging to M. Mênier, situated at Noisiel. The proprietor, well known by name, also, in this country, is the owner, also, of á large estate in Central America, entirely devoted to the cultivation of the cacao tree (*Theobroma cacao*), from which the nuts are obtained which serve for the manufacture of an article of diet which contains every element required for the due nourishment of the body. The factory at Noisiel employs 300 workpeople, and during the last ten months the quantity of chocolate made has amounted to 2,388,347 kilos. (fully 2388 tons); the quantity of tin-foil used for packing amounts to a value of 10,000 francs a month; and the duty paid by M. Mênier alone to the French *donane* amounts, for cacao alone, to a sum of nearly one and a half millions of francs yearly, exclusive of the sugar duties. M. Tresca states that the article is prepared with great care as regards the production of a really first-class and genuine material.

Cosmos, July 24, 1869.

Native Copper in Belgium.—While some drainage works were being executed at Vielsalm, province of Liège, the workmen found, at no great depth under the surface, a piece of native copper weighing about 2 kilos., and partly hollow inside, exhibiting crystals. This discovery has led to further research, the result of which is the finding of some veins of malachite.

Meteoric Appearance.—M. E. Arnoult, the well-known editor of *l'Institut*, writes from Vendôme, Département de Loir et Cher, about 80 miles south-west of Paris, stating that on the 15th of July, at 8.45 p.m., there was seen there a very bright meteor, which moved slowly from east to north, at an angle of about 45° above the horizon; it emitted a yellowish white light, so strong as entirely to overpower the light of the moon in her first quarter; it disappeared, without any perceptible noise or sound, in a few seconds, giving off a large number of very brilliant sparks. Since the writer of this brief communication is a good and trustworthy observer, and since he learned afterwards, that several other parties had recognised this meteor at about the same time, there can be no doubt about the fact that a peculiar appearance had been observed.

Geological Map.—We learn from this periodical that a very greatly improved and enlarged geological map of Central Europe has been prepared and edited by the well-known geologist, *emeritus* Director-General of Mines for Prussia, M. von Dechen. This new map is on a scale of 2,500,000ths, and embraces the whole of Germany, France, England, and adjacent countries. The same author has recently finished a large geological map, in 32 large sheets, of Rhenish Prussia and Westphalia, which may be considered as one of the best ever executed of the kind, and one of the finest specimens of chromo-lithography ever published. The price of these works being very moderate, will ensure them a largely-extended sale.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 10, *June* 12, 1869.

This is a double number of this periodical, containing, in the first place, a very interesting and lengthy account of a *soirée* given by the president of the Society, on the 15th of May last, at the chemical laboratory of Berlin University. Following the plan of the printed periodical, we quote, in the first place, the catalogue of the brilliant exhibition of objects of interest to the scientific party assembled; this catalogue is divided into three sections, comprising:—A. Exhibition of Chemical Preparations of High Scientific Interest.—(1) M. Baeyer, Berlin, "Preparations of Indol, honystone, preparations of mellithic acid;" (2) M. Darmstädter, Berlin, "Chlormethyl-isaethionate of sodium;" (3) M. H. Wichelhaus, Berlin, "β-binitronaphthalin and derivatives of naphthol;" (4) M. Frank, Stassfurt, "Collection of bromates and other bromine compounds;" (5) M. Gräbe, Berlin, "Compounds of chinon and artificial alizarine;" (6) M. Ladenburg, Heidelberg, "Preparations of silicium;" (7) M. Leibreich, Berlin, "Protagon, neurin, oxyneurin, and salts thereof;" (8) M. Martius, Berlin, "Victoria yellow, and compounds of binitro-kresol;" (9) M. Oppenheim, Berlin, "Mentha-camphor and derivatives of propylen;" (10) M. Scheibler, Berlin, "Collection of divers kinds of sugar, and models of the crystalline form some of these exhibit;" (11) M. Wichelhaus, Berlin, "Bibromo-pyroracemic acid and naphthol." B. Exhibition of Drugs, and of Products of Chemical Works.—This catalogue is by far too lengthy for reproduction; moreover, a great many of the substances exhibited are, if not better, at least equally well manufactured in this country; we notice, however, the following rare substances manufactured on the large scale: M. E. Jacobsen, Berlin, "Peroxide of hydrogen, made by a new and peculiar process." Among the extensive series of substances exhibited by MM. Lampe, Kaufmann, and Co., Berlin, we notice a collection of thirty different preparations of quinine; *ferrum dialysotum;* pure pepsin; a large collection of chemically pure essential oils, among which *oleum cajeputi, oleum calami, oleum neroli*, and a large number of others; a fine collection of rare kinds of opium, among these some of German cultivation. Dr. Marquart, Bonn, the owner of very extensive and eminently well-conducted chemical works, exhibited large quantities of ethyl-benzol, zinc-methyl (chemically pure), zinc-ethyl, ethyl-methylaniline, anhydrous sulphuric acid, anhydrous phosphoric acid, hydrochlorate of ethylamine, chloride of carbon, several distinct compounds of chlorine and phosphorus, aldehyde, carbonic acid ether, oxide of mesityl, and a number of similar rare compounds, all perfectly pure and fit for scientific research. M. Schering, operative chemist, Berlin, exhibited a group of crystals of re-sublimed iodine, 2 feet in diameter; several rare compounds of bromine with metals; chemically pure tannic and gallic acids; rare preparations of cadmium and mercury. C. Exhibition of Physical and Chemical Apparatus and Glass and Porcelain Ware.—This portion of the exhibition surpassed even the two former, not only for extent, but also for the exquisite novelty and finish and utility of the apparatus exhibited; we can only quote a couple out of the very many:—M. Elster, manufacturer of gas-meters, Berlin, exhibited a highly-sensitive photometer, and experimented with it during the evening in one of the rooms of the laboratory. M. Geissler, Berlin, exhibited his large mercurial air-pump, and showed experiments with it in the laboratory set apart for gas analysis.

We abstract the following from the speech of the President of the Society, Dr. A. W. Hofmann. After having welcomed his scientific guests, the Doctor first alluded to the fact that the laboratory wherein they met had not been opened in a more official manner, and a meeting held therein honoured by the presence of high and mighty officials and rulers of the empire; but, he said, it was far more agreeable to him to see assembled together, on the evening of the day upon which the finishing touch had been laid by the workpeople to this temple of science, men who would appreciate with him the importance of this achievement for the University of Berlin specially, and for the scientific world in general. The eminent speaker then entered into the history of the causes which so long delayed the building of really good laboratories at Berlin and Bonn, long after the four* other ancient universities of the Prussian empire, as it existed before the late

* Prussia Proper has Universities at Breslau, Konigsberg, Greifswald, Halle, Bonn, and Berlin; and in addition, the universities of Göttingen, Marburg, formerly belonging to the Kingdom of Hanover and the Duchy of Hesse Cassel, are now Prussian Universities.

conquests, had been amply provided with laboratories which were worthy of the advance of chemical science of the present day. The building of the Berlin laboratory, just finished though it has been in partial use for one year, occupies a space of 21·680 sq. ft. The building, of which, with the present number of the above-quoted periodical, three lithographic prints are given, exhibiting, respectively, its frontage and the plans of the ground-floor and first-floor, has cost 318,000 thalers (£47,700), which sum the Prussian Government has granted for the purpose. The speaker next commenced a lecture on divers scientific subjects, from which we quote the following:—

Increase of Weight During Combustion.—The main feature of this brief *exposé* is the description of an experiment. A small horse-shoe magnet is hung up at the beam of a balance sufficiently sensitive to turn with centigrammes; the poles of the magnet are immersed for a moment in the *limatura ferri* of the chemists' shops, and a beard of small particles of iron is caused to adhere to the poles; by means of proper weights placed on the scale-pan at the other end of the beam the equilibrium is restored. This having been done, the finely-divided iron is kindled, by approaching to it the flame of a Bunsen gas-burner, and continues to burn. While burning, it will be seen that the arm of the balance on which the magnet is suspended considerably deviates from the horizontal position, thus indicating an increase of weight on the side where the experiment is going on. This experiment succeeds best with a magnet of moderate dimensions; the horse-shoe magnet applied in this instance weighed, without its armature, 210 grms., and can bear a load of 12·5 grms. of iron; when this is altogether converted in magnetic oxide, by combustion, the increase in weight will be about 4·7 grms.

Formation of Ferric Acid.—An intimate mixture is made of one part of *ferrum limatum*, and two parts of nitrate of potassa. The speaker said he took, of both together, usually from 20 to 30 grms.; these are heated in a small glass flask over a strong gas flame; the mixture soon becomes quite incandescent, emits, out of the mouth of the flask, a firework of sparks, and leaves, at last, a mass partly fused together with the glass of the flask, consisting of ferrate of potassium. After cooling, this mass is reduced to powder, and, being exhausted with water, yields a deep reddish violet coloured, nearly transparent solution. Unless great care be taken to let the mass become quite cold before any water is added, the operation is spoiled.

We regret we can only quote the titles of the following subjects, briefly alluded to by the eminent lecturer, on account of the impossibility of properly giving any condensed review without reproducing the woodcuts annexed to the originals:—

Volumetrical Analysis of Hydrochloric Acid and Ammonia by means of Electrolysis.

Condensation of Hydrogen and Oxygen when forming Water-Gas (vapour of water at very high temperature).

Lecture-Room Analysis of Marsh Gas and Olefiant Gas.

Lecture-Room Eudiometer.

Equality of Volume of Oxygen, and of the Carbonic Acid and Sulphurous Acid obtained from it.

Oxidation of Ammonia.

Evolution of Oxygen from Nitric and Sulphuric Acids.

Experiments on Flame.

Lecture-Room Thermoscope.

Comparison of the Volume of Different Gases submitted to the same Changes of Temperature and Pressure.

Compression of Gases by means of the Pressure exercised by a Column of Mercury.

Liquefied Sulphurous Acid Gas.

Bubbles of Mercury Floating on Water.

Local Ventilation as Lecture-Room Experiment.—This last paper contains a brief *resumé* of the excellent mode of ventilation adopted in the lecture-room of the Berlin laboratory.

On the 24th of May last the Society held one of its ordinary meetings, at which the following papers were read and communications made:—

Behaviour of the Trichlorinated Acetic Acid Salts and of Chloral with the Animal Organism.—M. Liebreich.—This physiologico-chemical paper is partly an answer to the question the author put to himself—Whether, during the splitting-up of such chemicals, of which the physiological effects of the bodies they separately yield on being split up is well known, the splitting-up thereof in the animal organism itself brings on the same phenomena as if the component substances were individually administered to an animal? As far as the author's experiments go, they seem to prove that the splitting-up of substances as those experimented with and named in the heading to this paragraph, actually produce phenomena, from which it is just to infer that they are produced by products derived from the splitting-up of the substances experimented with.

Action of Sulphide of Carbon upon Oxamide and Acetamide.— M. Ladenburg.—The decomposition of oxamide sets in at 180°, and is not quite finished at 200°. In order to avoid explosions, the sealed tubes have to be opened after several hours' exposure to heat. Among the gases which escape on opening the tubes, oxysulphide of carbon is the chief, mixed, however, with some oxide of carbon and hydrosulphuric acid. The reaction may be represented by the following formula:— $C_2O_2N_2H_4 + CS_2 = CSNH.NH_3 + COS + CO$. As to the reaction of acetamide and sulphide of carbon, the author states—"I have never been able to get it satisfactorily ended; it begins below 200°, at 210° a strong disengagement of gas takes place, and at a higher temperature the tubes always exploded. The disengaged gases contain much H_2S, COS, and CO, also vapours of hydrocyanic acid, and combustible gases not absorbable by baryta-water and protochloride of copper. In the residue in the tube, only sulphocyanide of ammonium and acetamide were left.

Formulæ of Benzol.—M. Ladenburg.—It is impossible to give a proper abstract of this paper without reproducing the woodcuts representing certain mathematical figures essentially belonging to this paper.

Contribution to the History of the Salicyl Compounds.—M. Henry.—After referring to a series of experiments made by the author with the view of exhibiting the action of pentachloride of phosphorus upon salicylic aldehyde, the author now communicates the results of his researches on the action of pentabromide of phosphorus upon salicylic aldehyde. This action, he says, although less violent than that of the pentachloride of phosphorus, is yet rather strong. On purifying, first with water, and afterwards with ether, the substance resulting from this reaction, he obtained monobromated salicylic aldehyde—

$$C_6H_3Br \begin{cases} OH \\ CHO. \end{cases}$$

When two equivalents of pentabromide of phosphorus were made to act upon one equivalent of salicylic acid, a substance was obtained which, after having been purified by means of ether and alcohol, exhibited a crystalline appearance, fusing at about 165°, and subliming at between 150° and 155°; formula—

$$C_6H_3Br \begin{cases} HO \\ COHO. \end{cases}$$

Salicylic acid metyl-ether is not acted upon in the cold by pentabromide of phosphorus, but, on heating, among a series of secondary products, a substance is obtained named monobromo-salicylic acid ether—

$$C_6H_3BrCO(CH_3)O.$$

It is a solid, fusing at between 36° and 38°, and boiling at about 266°; its alcoholic solution is coloured beautifully

violet on addition of a few drops of an alcoholic solution of perchloride of iron.

Researches on some Ethereal Derivatives of Polyatomic Acids and Alcohols. — M. Henry.— Unless we were to fill about a column of our pages with formulæ only, the condensed reproduction of this paper would neither do credit to its author nor be of use to our readers; we therefore only quote the title.

Contribution to the Chemical History of Diallyl.—M. Henry.—This is a preliminary notice on diallyl, C_6H_{10}, from which we learn that diallyl readily combines with N_2O_4, yielding a solid mass of white crystals composed according to the formula $C_6H_{10}(NO_2)_4$. Diallyl also combines with hypochlorous acid, yielding a fluid heavier than water, formula—

$$C_6H_{10}\begin{cases}(OH)_2\\Cl_2.\end{cases}$$

On the Stilben Series. — M. Grimaux. — This paper, owing to the large number of formulæ necessarily belonging to it, is not well suited for abstraction.

Annalen der Physik und Chemie, von Poggendorff, No. 5, June 15, 1869.

This periodical contains the following original papers:—

Definition of the Course of the Boomerang.— Dr. E. O. Erdmann. — A purely mathematico-mechanical essay.

Researches on the Behaviour of Vapours as regards the Law of Mariotte. — Dr. H. Herwig. — A lengthy physico-mathematical monograph on this subject, not suited for abstraction.

Nature of the Liquids found Enclosed in certain Minerals.—MM. Vogelsang and Geissler.—The authors review, in this paper, first, the labours of Davy, Simmler, Brewster, and others on this subject, and next state that they have applied for their researches spectrum analysis and microscopic research. Without a reproduction of the engravings accompanying this paper, it would be impossible to make the apparatus, and the mode of action thereof, understood. It appears as chief result of the researches made by these authors, that liquefied carbonic acid and water are very commonly met with enclosed in various minerals.

Researches on the conditions Influencing the Evolution of Bubbles of Gas and Vapour, and on the Forces which thereby come into Play.—M. H. Schröder.—This paper is the first instalment of a lengthy essay on a rather intricate subject. Since the author intimates that he will give a condensed *resumé* of the main results of his researches at the end of his essay, we prefer not to go into particulars just now.

Reduction of Accurately-Made Weights, and Determination of the Error of Absolute and Relative Weighing Without Reduction. — Dr. K. L. Bauer.

Construction of Galvanoscopes which are Extremely Sensitive.—M. H. Weber.—These are purely mathematical papers.

Form and Constitution of the Puddling-Dross Crystals obtained at the Steel-Works, Hombourg-Haut, near St. Avold, Departement de la Moselle.—M. Kosman.—After reviewing the labors of others on this subject, the author first enters into a lengthy and purely crystallographical description of the crystals alluded to in the title. The specific gravity of this material is 4·44, the colour of the powder bluish green. In 100 parts, the substance contains:—Metallic iron, 0·29; monosulphuret of iron, 1·43; phosphuret of iron, 3·31; peroxide of iron and sesquioxide of manganese, 5·99; Fe_2O_3, 4·79; protoxide of manganese,* 0·75; lime,* 1·16; phosphoric acid,* 1·48; silica, 24·04; protoxide of iron, 47·50; protoxide of manganese, 7·35; lime, 0·82; magnesia, 1·49.

* The analyst considers that these three, equal to 3·39 per cent, are combined together according to the formula—
$(3MnO,PO_5)+2(3CaO,PO_5)$.

Determination of Galvanic Resistance.—M. J. Sirks.—A mathematical paper.

Spectrum of the Aurora Borealis.—M. J. A. Angstrom.—This paper is taken from the author's work, highly spoken of by M. Poggendorff, "Researches sur le Spectre Solaire," 4to, Upsal, 1868, avec Atlas de Six planches. The light exhibited by the Aurora Borealis is almost monochromatic, and shows one single bright line to the left of well-known lines of the calcium group.

Fluorescent Liquids for Geissler's Tubes.—Dr. Seilhorst.—The researches of this author have brought to light the fact that a good deal of deception is practised by the makers of the tubes, who make inaccurate statements as to the nature of the fluids they contain. The author found that *tinctura rad. curcumæ* answers best for yellowish green, *tinctura sem. daturæ* for deep green, *tinctura guajaci* for deep blue, *tinctura ligni quassiæ* for bright blue, *tinctura corticis Æsculi* for bluish green, and petroleum for bright blue. The author could not obtain a red fluorescence; all the tinctures are alcoholic.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 198, June, 1869.

This periodical contains the following original papers:—

Report on the Chocolate Manufactory of M. Menier, at Noisiel (Seine et Marne).—MM. Tresca and Duchesne.—This report has been already alluded to by us, abstracted from another paper.

Report on a Peculiar Process of Dyeing a Fast Grey.—M. Barreswil.—The author states that MM. Bretonnière and Co., at Laval (Mayenne), have introduced very successfully the use of protonitrate of mercury as a mordant; and they apply, as dye, a solution of sulphuret of potassium, using 1 kilo. of that salt to 18 kilos. of woven tissue, or yarn, dissolving the salt, of course, in a sufficient quantity of water. The colour thus produced is essentially due to the formation of sulphuret of mercury on and in the tissues; and, according to the author of this paper, the colour is fast, that is to say, not destroyed by washing with soap or alkaline lyes, and resisting acids, but destroyed by chlorine.

Purifying of Syrups and Molasses by means of the Osmogene.—M. de. Luynes.—This paper describes the details of M. Dubrunfaut's method of refining coarse syrups and molasses, by an apparatus called osmogène; but, unless the engravings annexed to this paper were reproduced by us, it would be impossible to understand the description properly.

The remaining papers in this number are—The continuation of a lengthy paper on—

Electro-Magnetic and Magneto-Electric Apparatus for Medicinal Applications;

A continuation of a report—

On the Culture of Truffles;

And a paper relative to locomotive engines.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 4, July 26, 1869.

A very considerable portion of this number is again devoted to an apparently never-ending dispute about the Pascal, Newton, and Chasles-Le Verrier controversy. Among the papers we notice:

Researches on the Products of Oxidation of the Principal Normal Alcohols.—MM. Pierre and Puchot. —The authors have used the well-known plan of acting with bichromate of potassa and sulphuric acid upon the alcohols submitted to experiment. They distinguish, among the pro-

ducts of this reaction, between the normal acid belonging specially to an individual alcohol, its aldehyde, and the compound ether, which are proper to each separate alcohol; for instance, with amylic alcohol, valerianate of amyl may be obtained; with butylic alcohol, butyrate of butyl may be produced. The authors describe, at great length, what precautions are in general required to be observed in experiments of this kind, and then specify the following particulars:—(1) The preparation of valerianate of amyl, $C_{10}H_9O_3$, $C_{10}H_{10}O$, by the oxidation of amylic alcohol; (2) the preparation of butyrate of butyl, $C_8H_7O_3$,C_8H_9O; (3) the preparation of propionate of propyl, $C_6H_5O_3$,C_6H_7O. These preparations are concisely described.

Proposed Plan of Protecting Iron Vessels against Rust and Corrosion.—MM. Dance and Bertin.—The plan proposed by these gentlemen for this purpose, is to convert the hull of the iron vessel into a galvanic battery by placing, inside the hull, pipes and tanks made of zinc and filled with sea-water, and connected, by means of bolts and rivets in metallic contact, with the outer side of the vessel. The authors of this paper also propose the use of strips of zinc on the iron plates of the vessel immersed in the water.

Correlation of the Unequal Visibility of Colours at Twilight, and their Unequal Photographic Activity in Full Daylight.—M. Keller.—The author observes that, after sunset, those colours which are the brightest when seen by daylight, become very dark—for instance, red, orange, and yellow; while blue, violet, and indigo, which are less bright when seen by daylight, become whitish (*blanchâtres*) in twilight. The author further observes that, in a photographic print, the first-named colours produce black, and the last-named grey. White light, producing all vibrations, is capable of exciting all colours; but, since, according to the researches of the Rev. Father Secchi, S.J., the light of the sky after sunset is especially rich in blue rays, it need not excite astonishment that the less refrangible rays should be, as it were, extinguished.

Action of Permanganate of Potassa upon Cinchonine.—MM. Caventon and Willm.—The principal products of the reaction of a very cold solution of permanganate of potassa added, *guttatim*, to a cold solution of cinchonine, slightly acidified with sulphuric acid, are:—(1) An indifferent, neutral compound, which unites with bases as well as with acids, which has been named by the authors, *cinchoténine;* (2) an acid capable of being obtained in crystals, which is named *carboxycinchonic acid;* (3) a substance which reduces the tartrate of copper and potassa. In addition to these compounds, the authors state that they have discovered, by this reaction, a new alkaloid, which is made up according to the formula $C_{20}H_{26}N_2O$, and which is named *hydrocinchonine.* This base fuses at 268°, cinchonine fusing at 257°; the former base is insoluble in water, difficultly soluble in strong alcohol at ordinary temperature, and more readily so in boiling alcohol. Cinchonétine, $C_{18}H_{20}N_2O_3$, is a solid substance, soluble in boiling water. Carboxycinchonic acid, $C_{21}H_{14}N_2O_4$, is a solid substance, pretty readily soluble in water, and obtainable in crystallinel state; it is a bibasic acid which forms with alkalies and baryta very soluble salts.

August 6, 1869.

Leaving, again, the purely mathematical and physico-mathematical papers, and also the voluminous papers on the controversy about the Newton, Galileo, Le Verrier, and Chasles papers and communications, we notice the following papers:—

Laws Governing the Solution of a Substance in Two Solvents.—MM. Berthelot and Jungfleisch.—This paper is not well suited for abstraction; but the subject it treats of may be stated in a few words, while we reserve the paper for more full treatment in our pages at a future time. All chemists know that it often happens that, in order to obtain from its solution, in water, for instance, they make use of ether, or other fluids not miscible with water, to extract therefrom any substance, *e.g.*, bromine or iodine, dissolved therein; the ether thus applied acts purely by its physical properties. The authors in this paper give, at length, the results of their researches on this subject which is very ingeniously treated.

Researches on Alloys.—M. Riche.—This paper is a continuation of a series of communications on this subject by the same author. While the hardening of steel has the effect of decreasing its density, as already long since stated by M. Caron, it was thought that this same effect was produced in bronze sonorous instruments, as, for instance, the Chinese gongs. The author finds that hardening and annealing are two operations the effect of which is totally different for steel and for bronze; whilst hardening has the effect of decreasing the density of the former, it increases that of the latter; annealing, on the other hand, increases the density of steel, and decreases the density of hardened bronze. Copper, repeatedly hardened and annealed, does not perceptibly vary in density.

A New Pyrometer.—M. Lamy.—The author proposes to use pure Iceland spar, basing the use of this substance, as a pyrometer, upon the law of dissociation.

Synthesis of Glucosides.—M. Schützenberger.—We reserve this paper for full translation in our columns.

Action of Anhydrous Sulphuric Acid upon Perchloride of Carbon.—M. Schützenberger.—When in perchloride of carbon, CCl_4, anhydrous sulphuric acid is dissolved, there is instantaneously observed a smell of phosgen gas, and when the solution is heated upon a water-bath, chloroxycarbonic gas is regularly given off. When this evolution of gas ceases, there remains in the retort a fuming liquid, which, on being submitted to distillation, yields, at about 75°, the excess of perchloride of carbon; next, the thermometer rises to 130°, and at that temperature nearly the whole of the liquid distils off. The distillate is a colourless liquid, fuming in the air, and, on contact with water, instantly decomposed into hydrochloric and sulphuric acids; on being analyzed, this liquid yields results leading to the formula, $S_2O_5Cl_2$, that is, an oxychloride of sulphur. The action of anhydrous sulphuric acid upon perchloride of carbon can, therefore, be represented by—

$$S_2O_6+CCl_4=S_2O_5Cl_2+CCl_2O.$$

Gases Given Off by Fruit.—MM. Lechartier and Bellamy.—The authors prove, in this paper, that various kinds of fruit, after having been plucked from the trees—for instance, apples, cherries, gooseberries, and currants—begin to absorb oxygen and give off carbonic acid. The paper enters into lengthy quantitative details on this subject; as a proof that the quantity of carbonic acid given off by large quantities of fruit, say apples, for instance, stored up, may be considerable; suffice it to notice that five apples, weighing together 348 grms., yielded, from the 19th of January last up to the 15th of July last, 6648 c.c. of carbonic acid gas.

New Synthetical Method for the Preparation of Naphthalin-carboxylic Acid.—M. Eghis.—The author mixes monobromide of naphthaline, chloroxycarbonic ether, and sodium amalgam; and, after a complicated set of operations and purifications, obtains, as result, a solid substance, readily soluble in alcohol, ether, and boiling water, fusing at 160°, and yielding, on elementary organic analysis, results leading to the formula $C_{11}H_8O_2$. An identical substance was obtained by Prof. A. W. Hofmann, from cyanide of naphthaline derived from oxalate of naphthalamine; the body here in question was named by the last-named *savant*, menapthoxylic acid, or naphthalin-carboxylic acid.

Cosmos, July 31, 1869.

We quote from this paper a brief account of—

The Rio Vinagre.—This river has its source at a height of 3500 metres above sea level, near a very difficultly accessible spot of the volcano named the Puracé. The late Alex-

ander von Humboldt first ascertained that the water of this river contains free sulphuric and hydrochloric acids. According to M. Boussingault, this river discharges into the Rio Cauca, wherein it falls from a height of 125 metres, during every twenty-four hours, 34,784 cubic metres of water, containing 37,611 kilos. of strong sulphuric acid, and 31,654 kilos. of concentrated hydrochloric acid. The Rio Cauca, after having received the waters of the first-named river, does not feed any fish for a distance of 18 kilometres of its seaward course. The volcano Puracé is not provided with a crater, as ordinarily met with on volcanoes, but its main outlet is a longitudinal split, 2 metres in length by 1 in width; it is covered at the top with a layer of very pure sulphur of about half a metre thick. There is at all times a strong escape of gases and vapours from the main outlet of this curious trachytic mountain, accompanied by a loud noise akin to that of the blowing off of the steam of several large high pressure steam-boilers. In the island of Java there are several rivulets and small lakes also containing free sulphuric and hydrochloric acids; while in one locality on the island of Sumatra, a lake is met with which contains free nitric acid. All these phenomena are caused by active volcanic action.

The American Journal of Science and Arts, No. 141, May, 1869.

We notice from this periodical the following original papers, omitting such as relate to astronomy, mathematics, and mechanical science:—

Atomic Volumes of the Elements.—M. Frank Wigglesworth Clarke, S. B.—This is a continuation of an essay on this subject from former numbers of this periodical. The author says, in his introduction to this part:—"In a recent paper in this journal I called attention to some remarkable relations which seem to exist between the atomic volumes of certain elements in the liquid condition. Since that time, I have found similar relations between the same elements in solid state, and also between the atomic volumes of some other solid elements, of which no liquid compounds are known. A few relations between the atomic volumes of different metals have been previously observed; chief of these, we find the equality of the atomic volumes of the metals of the iron group, the similar equality connecting the platinum metals, the equality between silver and gold, and that between molybdenum and tungsten. But, as far as I have been able to learn, nothing seems to have been done towards studying the more remarkable multiple relations which connect the members of certain natural groups together." The author next proceeds to the review of the alkaline metals, quoting the specific gravities as follows:—Lithium, 0·589; sodium, 0·972; potassium, 0·865; rubidium, 1·52. Upon dividing the atomic weights of the four metals, by these specific gravities, we get, as their atomic volumes, respectively, the numbers 11·9, 23·7, 45·1, and 56·2. It will be at once seen that the three highest of these values are very nearly multiples by whole numbers of the lowest. The author reviews, next, the oxygen group, oxygen, sulphur, selenium, and tellurium; after this, the nitrogen group, the carbon group, and metals. The very brief sketch given here may, perhaps, be followed by a more full and extended abstract in our journal afterwards.

On some Minerals from Newlin Township, Chester Co., Penn.—S. P. Sharples.—The first mineral described is *Diaspore*, containing, in 100 parts:—Silica, 43·56; alumina, 38·16; water, 5·64; potassa, 10·81. Specific gravity, 2·87. Colour varies from white to greenish or yellowish; it fuses before blowpipe-flame with extreme difficulty, forming a white enamel. *Lesleyite.*—Colour, white to reddish; hardness, about three; streak, white; before blowpipe-flame, loses water; does not fuse with borax; does not dissolve in hydrochloric acid; is specifically heavier than quartz, its specific gravity being 3·203. It contains, in 100 parts:—Silica, 33·59; alumina, 55·41; potassa, 7·43; water, 4·30. *Pattersonite* contains in 100 parts:—Silica, 30·20; peroxide of iron, 14·88; alumina, 20·55; magnesia, 1·28; potassa, 11·35; water, 11·73.

Note upon the Origin of the Phosphatic Formation.—C. U. Shepard, sen.—The formation here alluded to is a very extensive one found in Southern Carolina. The paper is entirely of geological interest only.

On some Derivatives of Trichlormethyl-sulphon-Chlorid, $(CCl_3)SO_2Cl$.—M. O. Loew.—This paper will be given *in extenso* in our next number.

Notes on the Occurrence and Composition of the Nodular Phosphates of South Carolina.—C. U. Shepard, jun.—It appears that the specific gravity of this phosphatic mineral varies from 1·94 to 2·54; the quantity of water varies from 5·60 to 9·15; carbonic acid varies from 2·55 to 6·62; sulphuric acid, from 1·8 to 25·7; phosphoric acid, from 24·95 to 30·17, all in 100 parts. The mineral contains, besides lime, alumina, oxide of iron, magnesia; sand, varying from 4 to 15·7 per cent; and traces of chlorine, fluorine, and sodium. The author adds the analysis of the water of an artesian well, at Charlestown, S. C. This well is 1250 feet deep; the temperature of the water at the spout is 87° F. Specific gravity of the water, at 15°, is 1·0015; the amount of solid ingredients in the water = 0·228 to 0·234 per cent. In 100 parts of solid ingredients are found:—Bicarbonate of soda, 52·749; chloride of sodium, 47·051; bicarbonate of lime, 0·0883; bicarbonate of magnesia, 0·01375; silica, 0·00102; phosphates of lime, iron, and alumina, 0·0004; organic matter, 0·0017. In 100 imperial gallons of this water at 15° are contained about 1½ lbs. of bicarbonate of soda, and 1¼ lbs. of common salt.

Certain Phenomena of Transmitted and Diffused Light.—Carey Lea.

The Cohahuila (Mexico) Meteoric Irons of 1868.—Mr. J. Lawrence Smith.—It appears that the region of Mexico bordering on Texas has been most profusely furnished with these celestial visitors; six masses, weighing, respectively, 290, 430, 438, 550, 580, and 654 lbs., have been brought to the United States. They are irregular compact masses, without any evidence of stony minerals; they belong to the softer irons, not difficult to cut with a saw. A sample taken from one only of these masses has been as yet submitted to research. Specific gravity, 7·692. It contains, in 100 parts: Iron, 92·95; nickel, 6·62; cobalt, 0·48; phosphorus, 0·02; copper, a very minute quantity.

On Atomic Ratio.—Mr. Josiah P. Cooke, jun.—This paper treats on the so-called oxygen ratio used by mineralogists, and is more a mineralogical than strictly chemical paper.

Formation of Sugar in the Liver.—Dr. George F. Barker.—A physiologico-chemical essay.

This number of the periodical contains, as usual, a copious amount of scientific intelligence, but, since this is chiefly a reproduction from European prints, or is otherwise of local interest only, we do not notice it, the more so as there is nothing therein contained of interest which has not already been noticed by us in our journal.

Annalen der Physik und Chemie, von Poggendorff, No. 6, 1869.

This periodical contains the following original papers:

Cohesion Exhibited by Rock-Salt in Different Crystallographical Directions.—Dr. Sohncke.—The author of this paper gives an account of his experiments on the resistance exhibited by rock-salt to tractive forces, applied thereto in a similar manner as is done to wood, metallic wires, and other solids. The paper is, however, not well suitable for proper abstraction with due justice to the author's labour, and could not, moreover, be well understood without the reproduction of a large number of tables.

Description of a Photometrical Method of Measurement and Comparison of the Intensity of Coloured Light.—M. C. Vierordt.—A large-sized engraved plate accompanies this paper.

Isolating Intermediate Layer (Zwischenschicht) of a Condenser.—M. W. von Bezold.—A mathematico-physical essay.

Point of Solidification of the Component Portions of Fluid Mixtures.—C. Schultz.—The author proves, by quoting a large number of instances, that, in a mixture of solid bodies which are miscible in a fluid state, without thereby calling forth chemical reactions, a return to the fluid state, may, and actually does, take place at a temperature below the melting-point of the most easily melting substance. This fluidization takes place more readily, and with a less amount of absorption of heat, when the temperature, at the time of making the mixture, is so high that one of the component parts thereof is already fluid, as, for instance, is the case when salts are dissolved in water, or in alcohol, and when amalgams are mixed with mercury. The author of this paper records a large number of substances he has experimented upon.

Freezing Point of Water containing Gases in Solution, and on the Regelation of Ice.—M. Schultz.—The author states that, as a general rule, the point of solidification of fluids is lowered by substances dissolved therein, and that gases dissolved in fluids exercise the same effects. The fusing point of pure acetic acid is 16°; this is lowered to 15·2° when a current of carbonic acid is transmitted through this acid. That hydrochloric acid gas and ammonia gas do lower the freezing temperature of the water they are dissolved in is a well-known fact; carbonic acid and sulphurous acid gas do the same; and the author found that nitrogen, oxygen, and hydrogen gases exert, when dissolved in water, the same effect. The author records a series of experiments made by him with the view of ascertaining the effect of an increase of pressure brought to bear upon the absorption of various gases by water, and the lowering of the freezing point of that liquid in consequence thereof. By the phenomenon of regelation is understood that property exhibited by ice of freezing together to a solid mass, when pieces of that substance are pressed together at the temperature of 0°. After quoting the opinions of Messrs. Faraday, Forbes, Thomson, and Helmholtz on this subject, the author says—When we take it for granted that regelation is the formation of ice from water anew, we must bear in mind that only pure water, or water, at least, not saturated with air, is suitable for this purpose. The author has studied the influence divers gases exert upon this phenomenon, but the description of his experiments is too lengthy to admit of further quotation.

Fluids Enclosed in Minerals.—M. Vogelsang.—This paper is an appendix to a paper on the same subject published in a former number of this periodical. The chief result of the author's researches is the fact that fluid carbonic acid is far more generally met with enclosed in large masses in stone, and that the conditions under, or during which that condensation took place, are as yet only very scantily known.

Influence which Mechanical Changes Exert upon the Capability of Magnetical Rotation of some Substances.—M. R. Lütge.—This essay is entirely of a mathematico-physical nature, and there belong to it a series of engravings, which render the paper not well suitable for abstraction.

Application of a Steel Magnet, armed with a Wire Spiral, to the Dynamo-Electrical Machine.—Dr. Sinsteden.

Improved Arrangement of Leclanche's Element, and a New Self-Acting Commutator.—Dr. Sinsteden.

On Laxmannite, a New Mineral from Beresowsk.—M. Nordenskjöld.—While making some researches on minerals containing vanquelinite, met with in the large mineralogical museum at Stockholm, the author found a mineral containing a double salt of chromic and phosphoric acids, which mineral he has named laxmannite, in honor of the late Professor Laxmann, who, while making a journey through Siberia, in the year 1773, brought back to Sweden a great number of minerals from the former country and from the Ural mountains. Laxmannite has a specific gravity of 5·77; its colour is dark olive-green; on heating, it loses a very slight amount only of water, fuses before the blowpipe-flame, yielding a blackish-coloured bead. When treated before blowpipe-flame with boracic acid and iron wire, it exhibits the well-known reaction for phosphoric acid; while, on being fused with soda and saltpetre, it exhibits the reaction for chromic acid; it is soluble in nitric and hydrochloric acids, chloride of lead being separated thereby. The formula of this mineral is—

$$(CuO\tfrac{2}{3}H\tfrac{1}{3})_3PO_5 + 3(PbO, CuO)_2{}'CrO_3;$$

and it consists, in 100 parts, of:—Oxide of lead, 61·48; oxide of copper, 13·13; chromic acid, 16·57; phosphoric acid, 7·83; water, 0·99.

Behaviour of the Iodates and Periodates when Submitted, to Heat, and the formation of the latter from Iodides by means of Peroxides.—M. C. Rammelsberg.—The author first points out a very remarkable difference between the iodate of potassa and the iodate of soda; the former salt, when heated, yields oxygen and iodide of potassium; the latter salt crystallises, containing 8·33 per cent of water, which is driven off at 150°. Various experimenters have stated that this salt always loses iodine when heated; others, again, have denied this. The author finds that, unless the iodate of soda is, previous to being heated, mixed with carbonate of soda, iodine is always set free. As regards the periodates, the author has submitted a number of them to properly-defined higher temperatures, and found that periodate, of potassa remains unchanged, even at 200°, but at 300° it is entirely changed into iodate of potassa. The periodate of silver changes, at 175°, into iodate of silver; normal periodate of ammonia detonates on being strongly heated, yielding iodine, nitrogen, oxygen, ammonia, and water. The author has devoted a large portion of this paper to a record of his experiments on the action of iodine upon baryta and the peroxide of barium. Curiously enough, these researches have brought to light the fact that pure baryta is by no means so readily obtained as one might feel inclined to imagine, even though the product of the ignition of nitrate of baryta contained only very minute traces of silica and alumina. The author found that there is about 3 per cent deficiency therein, for, instead of finding Ba 89·54 per cent, he found Ba 86·36 per cent, and even less; and he is inclined to assume the existence of a compound Ba_3O_4; on treating baryta with iodine at higher temperature, compounds were obtained consisting, in 100 parts, of :—Ba, 58·6, I, 32·0; Ba, 56·8, I, 34·1; Ba, 57·0, I, 33·8. These compounds all contain oxygen, and the author gives the formula $Ba_3I_2O_4$. Peroxide of barium behaves in a similar manner with iodine.

Formation and some of the Reactions of the Periodates.—M. Philipp.—This paper is a lengthy essay on this subject, and too full of formulæ to admit of useful abstraction.

On the Krahenberg Meteorite, fallen on the 5th of May, 1869.—M. vom Rath.—It appears that, on the date just alluded to, there fell, at a small village in the Bavarian palatinate, near to Deux-Ponts, a meteoric stone, accompanied by a strong detonation. The author describes this stone at length, and also describes his method of analysis of this stone. In 100 parts, it consists of:—Chromate of iron, 0·94; sulphur, 2·25; iron, 3·47; silica, 43·29; alumina, 0·63; magnesia, 25·32; lime, 2·01; protoxide of iron, 21·06; protoxide of manganese, a trace; soda, 1·03. The specific gravity of this stone is 3·4975 at 18°. The analysis just quoted has been made after a portion of the pulverized stone had been repeatedly treated by means of a magnet to extract metallic iron and nickel; the powder thus separated by the magnet was found to consist, in 100 parts, of—Iron, 84·7; nickel, 15·3. The weight of the entire meteorite was found to be about 30 lbs.

Bulletin Mensuel de la Société Chimique de Paris, July, 1869.

This periodical contains the *procès verbaux* of the meetings of this Society, held on the 7th and 21st of May last, from which we learn that M. Silva described—

Some Compounds of Isopropyl.—The valerianate of isopropyl boils at 142°; its specific gravity, at 0°, is 0·870; and its vapor density 5·04. The author has tried to prepare trisisopropylamine; he obtained, however, a liquid exhibiting a strongly alkaline reaction, which distils over between 80° and 120°, and which the author thinks is a mixture of di- and tris-isopropylamine. By making butyrate of silver act upon iodide of isopropyl, the author obtained the butyrate of isopropyl ether, $C_4H_7O_2C_3H_7$, boiling at 128°, under a pressure of 755 m.m. The specific gravity of this fluid, at 0°, is 0·8787; its vapor density, as found by experiment, is 4·730. By causing nascent hydrogen to act upon the monochlorhydrine of the amyl-glycol, the author has obtained a product very much resembling amylic alcohol, as was discovered by analysis.

Synthesis of Glucosides.—M. Schutzenberger has tried to effect this by boiling a solution of *saligénine sodée* in benzine with triacetic glucose, which is slightly soluble in that liquid; and, by evaporating the filtrate on a water-bath, a substance was obtained which is viscous at 100° and solid when cold. This compound answers the characters of the glucosides; it is split up into glucose and salicetine, yielding then, also, acetic acid. This glucose is, however, a modification of that substance known as glucosane; its reducing power is less strong than that of ordinary glucose. The residue insoluble in benzine is entirely soluble in water, with the exception of a small quantity of resinous matter; the aqueous solution yields to ether a crystallisable compound, which possesses all the characteristics, also, of a glucoside, but does not contain acetic acid; its composition is $3C_{14}H_{23}O_3,C_6H_9O_3$.

M. Vogt stated that, while treating the chlorobenzylsulphate and chlorotolylsulphate of potassium with fusing caustic potassa, he has obtained salicylic and cresotic acids.

The following original papers are contained in this number of the above-named periodical:—

Immediate Analysis of the Divers Varieties of Carbon.—M. Berthelot.—We published in full the contents of this paper some time ago.

Comparison between the Saline Constituents of the Grease of Sheep's Wool and the Human Perspiration.—M. S. Cloëz.—In this elaborate paper, the author first reviews the researches of M. Vanquelin and M. Chevreul on this subject; he then briefly refers to M. Evrard's patent, for extracting, from the grease of sheep's wool, carbonate of potassa, which process has been brought to perfection by MM. Maumené and Rogelet, and is carried on on the large scale with success. The two last-named gentlemen, having published some scientific researches on this matter, have come to the conclusion that pure grease of sheep's wool was devoid of soda or salts of this alkali. The author of this paper proves, by a series of analyses, that although in the grease of sheep's wool potassa salts prevail, the salts of soda are not altogether absent. As instances of the composition of the saline constituents of this material, we quote, out of the large number of analyses, a couple of instances:—Grease from sheep's wool taken from animals in pasturage near the sea contained saline matter, in 100 parts, composed of—Carbonate of potassa, 84·80; sulphate of soda, 4·65; chloride of sodium, 10·45. Another sample contained, in 100 parts—Carbonate of potassa, 87·27; sulphate of potassa, 3·59; sulphate of soda, 0·68; chloride of sodium, 8·27. The saline constituents of human perspiration the author found to contain:—Carbonate of potassa, 31·82; sulphate of potassa, 11·76; chloride of potassium, 16·02; chloride of sodium, 38·54.

Relative Proportion of Alkalies found in the Ash of Divers Plants.—M. Cloëz.—This paper is a valuable addition to the methods of ash analysis of plants; but the author chiefly desires to call attention to facts observed already by the late MM. Ingenhousz, Senebier, and Johnston—namely, that the same plants grown near the sea, and at remote distances therefrom, alter their saline constituents, so that, while growing near the sea, soda prevails, as a rule, over potassa, the reverse being the case while the same plant vegetates at a distance more or less remote from the sea; of this fact, some instances are given in this paper. The relation of the soda to the potassa of the ash of *Crambe maritima*, when grown near the sea, was as 960 to 1000; when grown at Paris, as 89 to 1000. The relation of soda to potassa in the ash of black mustard seed grown near the sea was as 200 to 1000, while when grown at Paris, it was as 96 to 1000.

Supersaturation and Dissolution.—M. Lecocq de Boisbaudran.—This paper is a critical review of a paper published in the *Comptes Rendus*, and is not well suited for abstraction.

On Nucitannic Acid.—Dr. Phipson.—The author says that he has discovered, in the epispermium of walnuts, a peculiar kind of tannin, to which he has given the name of nucitannic acid or nucitannin. It is soluble in water and in alcohol; is precipitated by subacetate of lead; while its most remarkable property is that, when boiled with dilute acids it is split up into glucose, and a reddish-coloured substance, called by author *rothic acid*, since it has acid properties, and is soluble in ammonia and alcohol. The nucitannic acid is accompanied by ellagic and gallic acids, which interfere, the author says, with the purifying of the nucitannic acid; about the latter, and about rothic acid, the author promises further communications when his researches shall be complete.

Chemisches Centralblatt, No. 26, June 30, 1869.

This number does not contain any original papers, and the whole of its contents have been noticed by us previously from the originals.

Moniteur Scientifique, No. 302, July 15, 1869.

This paper contains a very lengthy essay on—

Designolle's Gunpowder.—M. Jouglet.—The paper is evidently written with the view to bring, if possible, into general use a powder containing pierates, in addition to nitrate of potassa. The paper is too much an essay written for artillery purposes to render it peculiarly suitable for abstraction; but, incidentally, the author speaks of nitroglycerine, and, while on this subject, he positively asserts that nitroglycerine, even when well and carefully made, is spontaneously altered by keeping, becoming acid, and then disengaging gas. This the author asserts is the true clue to the fearful explosions now and then witnessed with this material; and he concludes that if it is to be used at all, it should be made on the spot where it is wanted, and only in such quantities as may be required for blasting during one, or at most two days before.

Among the specifications of French patents, we notice the patent granted to M. Collas, for the—

Application of Phosphate of Lime for Dyeing and Calico Printing.—The author calls attention to the fact that phosphate of lime yields, with various vegetable colours, lakes which are different from those obtained with alumina; that the oxides of copper and cobalt yield, with the freshly-precipitated phosphate of lime, blue-coloured lakes, which greatly surpass, in richness of colour, Thénard's and other blues. The principle of this patent has been long enough known, and, as well remarked by the editor of this paper, it is very questionable whether this matter should be subject to any patent at all.

New Kind of Heating Apparatus for Chemical Laboratories.—M. E. Kopp.—This is a rather lengthy

description of a complicated set of apparatus intended for heating the laboratory in winter, and, at the same time, supplying at all times a drying stove for filters, &c. The paper describes two kinds of apparatus, in one of which heated air, while in the other steam is applied. It does not, however, appear, from the description, that anything decidedly good is effected by these apparatus, which, from the complicity of construction, cannot but be very expensive; moreover, to be well and readily understood, this paper ought to have been accompanied by a woodcut.

Tinning by the Moist Way.—Dr. Hillier.—It is a well-known fact that, when it is desirable to cover metals, especially brass or copper, with a strongly-adhering coating of tin, this is usually effected by boiling the articles to be thus coated with an aqueous fluid, to which is added cream of tartar, crystallised protochloride of tin, and some lumps of pure metallic tin. The author states that, instead of this mixture, he uses, with very good success, a solution of 1 part of protochloride of tin in 10 parts of water, to which he next adds a solution of 2 parts of caustic soda in 20 parts of water; the mixture becomes turbid, but this does not affect the tinning operation, which is effected by heating the objects to be tinned in this fluid, care being taken, at the same time, to place in the liquid a piece of perforated block-tin plate, and to stir up the fluid during the tinning with a rod of zinc.

Annales des Mines, No. 2, 1869.

This periodical contains the following original papers:—

Some Peculiarities in the Working and Manufacture of Bessemer Steel in Styria and Carinthia.—M. Clérault.—The author of this paper states that, owing to the special advantages due to the excellent iron ores of the countries above named, the manufacture of steel, according to Bessemer's method, is effected with less cost, and yields better results, than is the case elsewhere. The paper is full of practical matters, especially as regards the manufacture of railway iron.

Certain Peculiarities of the Blast Furnaces of the Siegen District.—M. Douville.—The author of this short memoir describes the peculiarities of the blast furnaces established a few years ago in this district of Prussia, wherein, centuries since, iron-works have been in existence, but where only recently the use of coke has been substituted for that of wood. The author's paper is valuable chiefly to ironmasters.

Geological Description and Account of the Mineral Resources of the Canton de Vic Dessos.—M. Mussy.—This is the third and concluding portion of a lengthy monograph exposing the mineral resources, and describing the geology, of that portion of the French Département de l'Ariège, which is contiguous to the republic of Andorra, a country wherein mineral wealth abounds. The paper is an excellent monograph on such a subject.

Journal fur Gasbeleuchtung, June, 1869.

This periodical contains an excellent monograph on photometers and their applications under the title of—

Photometrical Studies.—Dr. Rüdorff.—The author's memoir is too lengthy, and enters too deeply into mathematical details, to render it suitable for abstraction, but it is, in every respect, an excellent essay on this subject, and duly applied to practical purposes also.

This number contains the first portion of the report of the annual meeting of German gas engineers, held this year at Cobourg. From this report, we learn that, when hydrate of lime is saturated with carbonic acid, it is yet, provided it be moist, capable of taking up sulphuretted hydrogen very energetically, without thereby simultaneously giving off again carbonic acid gas. One of the members of this Association explains, in a few words, that the removal of sulphur from the oxide of iron used in the purifiers may be advantageously effected by means of quicklime; but no particulars of this process are given.

Les Mondes, July 29, 1869.

We notice from this paper:—

The Champonnois Press.—The name of M. Champonnois as an indefatigable industrial genius, is well and very deservedly known to all acquainted with the manufacture of beet-root sugar especially. We learn, from a short notice in the above-named periodical, that the gentleman just named has succeeded in bringing out a very greatly improved press for forcing the saccharine juice out of beet-root pulp so as to obtain a larger quantity of saccharine matter from a given weight of pulp, and also to bring the juice to a state of clearness (that is to say, absence of suspended matter) not hitherto obtained. Experiments with this kind of press, which is worked, moreover, with great economy of power, and yet with enormous force, may be witnessed at the works of MM. J. F. Cail and Co., Quai de Grenelle, Paris, where a large number of these presses have been made to order by beet-root sugar manufacturers, to be applied in the ensuing season.

The Academy of Exact Sciences at Madrid has proposed the following prizes to be distributed in 1871:—To discover the best method of making starch in Spain. Description to be given of the divers varieties of vines cultivated in certain parts of Spain, excepting always the provinces of Asturia, Pontevedro, Biscaya, and Castellon de la Plana. Do scription to be made of the various rocks met with in one province, at least, of Spain; to indicate their *detritus*, and to point out how this *detritus* contributes to the formation of the agricultural soil in general, and in how far this soil is suitable to the cultivation of trees. The premiums for the approved memoirs are a gold medal and a sum of 1575 francs (£63). The memoirs (written in Spanish, Latin, or French) must be received by the Secretary of the Academy, on or before the 1st of May, 1871.

The Journal of the Franklin Institute, June, 1869.

A large portion of this excellent periodical is devoted to engineering facts. Among the original communications relating to chemistry we find:—

Sugar and Starch from Sweet Potatoes.—M. H. Bartol presented, at the last meeting of this Institute, samples of sugar and starch, and the following analysis made in November last, from the juice of North Carolina sweet potatoes (per cent):—Sugar, 10·50; starch, 6·00; various salts, 1·17; gum, &c., 0·33; water, 82·00. By the use of powerful presses, 90 per cent of the weight of the potato can be obtained in juice; the density of this juice is 10° Beaumé= 1·075 sp. gr. These potatoes, the author says, will yield 6·18 per cent of sugar and 5 per cent of starch; but, by improved culture, as evidenced in Europe in the instance of beet-root, this quantity may be largely increased.

Tin in Missouri.—M. Williams.—This gentleman, in a note addressed to the editor of the above periodical, states that the granitic rocks of south-east Missouri are all more or less charged with stannic acid, so that there is a fair prospect of obtaining tin ore in quantity in that country.

The larger number of papers of this number relate to engineering and astronomy, rather than to chemistry or sciences allied therewith.

American Journal of Pharmacy, July, 1869.

This periodical contains a very large amount of excellent matter, but most of it belongs too strictly to pharmacy to be suited for our pages. We abstract the following papers:—

Bicarbonate of Ammonia as a Pharmaceutical Preparation.—W. Procter, jun.—The author begins by stating that he has used this salt as an antacid, instead of bicarbonate of soda, above which it is preferable, owing, also, to its somewhat stimulating powers. As to the formation of this salt the author says—It is well known to druggists that considerable quantities of this salt are formed on the sides of casks in which carbonate of ammonia is imported, and other portions are derived from the accidental or careless exposure of the sesquicarbonate of ammonia, whereby an equivalent of mono-carbonate is lost. It has been usual to reserve the salt thus obtained for forming acetate, nitrate, or other ammoniacal salts; but it is rarely used medicinally on its own merits. If it were sufficiently abundant or could be prepared cheaply by a direct process, it would form the best yeast powder that can be offered, since it contains a larger portion of carbonic acid than any of the alkaline bicarbonates except that of lithia, which is, of course, unsuited to this use. Bicarbonate of ammonia in its purest state is a white salt, isomorphous with bicarbonate of potassa, and possesses the same crystalline form; its composition is expressed by the formula NH_4O2CO_2,HO; its taste it saline, with a slight ammoniacal impression, and is slowly volatile when exposed, and gradually evaporates with a slight odour of ammonia; it is soluble in eight parts of water at 60° F., and its aqueous solution exhibits an alkaline reaction with syrup of violets; it is decomposed by the heat of boiling water, giving off carbonic acid; it is nearly insoluble in strong alcohol, but soluble in 60 parts of dilute alcohol; it is readily prepared on the small scale, by dissolving out the mono-carbonate from the powdered sublimed sesqui-carbonate (which consists of one equivalent of each salt) by means of alcohol of 85 per cent, in which the bicarbonate is almost insoluble. When a saturated solution of sesqui-carbonate of ammonia in water is saturated with CO_2, a quantity of the bicarbonate separates in crystals, owing to its less solubility.

Sweet Quinine.—W. Procter, jun.—It appears that, under this name, there has been thrown into commerce, by M. F. Stearns (U. S.), an article which, according to a statement made in the manufacturer's circular, appeared to be quinine associated with liquorice sugar. The author of this paper very properly states that the article in question, having been submitted by him to chemical tests, does not contain any quinine at all, but mainly cinchonine, precipitated from the sulphate, dried and triturated with an impure glycerrhizin prepared from liquorice root. The tastelessness of "sweet quinine" is due to the very difficult solubility of cinchonine, which requires nearly 4000 parts of cold water; with acid or alcoholic fluids, which salify and dissolve it, its bitterness becomes apparent.

The remainder of the papers of this excellent periodical are not suited for abstraction in our pages, for the reason already given.

Bayerisches Industrie und Gewerbeblatt, June, 1869.

This number contains, besides a large collection of official communications, among which is a well-digested and arranged law for limited liability companies, the following original papers:—

Utilisation of the Waste Products of Soda and Bleaching Powder Manufacture.—M. Zängerle.—The contents of this paper are, in some form or other, known to our readers, as this subject has been fully treated of in our columns. This paper does not teach us anything new, and therefore we quote nothing more from it than this—that, in Germany, the manufacture of sulphur from soda waste, and of peroxide of manganese containing 60 per cent, is carried out largely, and with success.

Use of the Miesbach Coal as Fuel at the Salt-work of Hall, in the Tyrol.—M. Hailer.—This paper is chiefly of local importance; but it may be noticed that the coal here alluded to, while containing 18·6 per cent of ash, and being chiefly small coal, containing, on an average, 52 per cent of carbon, is yet successfully applied to heat the salt-pans, at almost nominal cost, since the furnace is so arranged as to get the most heat from the fuel.

Jet-Black China Varnish.—M. Marx.—Under the above name is sold a varnish for boots and shoes, which, according to the author's analytical researches, chiefly consists of an alcoholic solution of shellac. According to the author, an excellent imitation of the original may be made by dissolving 10 grms. of shellac, and 5 grms. of turpentine, in 40 grms. of strong methylated spirits, in which fluid should be previously dissolved 1 grm. of extract of logwood, with some neutral chromate of potassa and sulphate of indigo. The varnish is to be kept in well-stoppered bottles.

Parisian Copying Ink.—M. Marx.—To make this, take 30 grms. of extract of logwood, and 7·5 grms. of crystallised carbonate of soda; boil this with 240 grms. of water, and add, while vigorously stirring, 30 grms. of glycerine. When the fluid has become cold, dissolve in it 1 grm. of neutral chromate of potassa, and add, lastly, 7·5 grms. of gum arabic, previously made into a thick mucilage with water. The paper upon which it is desired to transfer a copy need not be moistened if this ink is used.

Mixture for Producing "Japanese Lightning."—M. Marx.—Anhydrous saltpetre (nitrate of potassa), 33·3 parts; charcoal from lime-tree wood, 58·3; flowers of sulphur, 8·4. As to the name of Japanese lightning, it means the same as the Japanese matches Prof. A. W. Hofmann spoke about a couple of years ago, at a meeting of the Chemical Society.

Zeitschrift für Chemie, von Beilstein, No. 13, 1869.

This number contains only one original paper, the great bulk being abstracts from various periodicals written and published in English, French, Italian, and German languages. The original paper alluded to is on—

Hæmatoxyline and Hæmateine.—D. Tabensky.—The author states that, since MM. Erdmann and Hesse had discovered that hæmatoxyline reduces solutions of silver and becomes coloured red by the action of direct sunlight, he was induced by Prof. von Babo to make some experiments in order to discover whether the alcoholic extract of logwood might not be very serviceable in photography. For this purpose the author prepared hæmatoxyline in pure state according to Erdmann's method, taking care to re-crystallise the substance repeatedly from an alcoholic solution. Next, two glass plates, properly prepared, were exposed, in a photographic apparatus, to light, and afterwards one of these plates was treated, as usual, with pyrogallic acid, the other with a solution of hæmatoxyline. The success of the latter operation left nothing to be desired, and the further experiments of the author leave no doubt whatever that hæmatoxyline may be advantageously applied in photography. The quantities best suited for this solution are as follows:—Hæmatoxyline, 0·5 grm.; distilled water, 80 grms.; 22 grms. of acetic acid of 33° strength; and a small quantity of glycerin. The method of preparation of hæmateine has been altered and improved by the author of this paper in the following manner:—By means of an aspirator, air is drawn through a bottle filled, for one-third of its capacity, with liquid ammonia; and the current of air thus charged with ammonia is made to pass slowly over and through hæmatoxyline suspended in water; but care is to be taken that the glass tube through which the air charged with ammonia strikes should only just dip very slightly under the surface of the water; by this means, excess of ammonia is excluded, and the formation of amorphous brown substance is prevented. By this method, from 10 to 12 grms. of hæmatoxyline are changed, within three hours, into hæmateine, yielding a magnificently purple-coloured solution, which is precipitated by bisulphite of ammonia when cold; but, on heating, this precipitate becomes re-dissolved. Hæmatoxyline is, accord-

ing to M. Hesse, composed of $C_{32}H_{14}O_{12}+2HO$; hæmateine is $C_{32}H_9O_9+HO$. The former substance is a very weak acid, rather difficultly soluble in water, but very readily in an aqueous solution of borax; it is best and easiest prepared from the extract of logwood met with in commerce.

On Dichloraldehyde.—M. E. Paterno.—This paper, being taken from an Italian periodical which does not come to England, is therefore abstracted. The author states that he treated dichloraldehyde with chloride of phosphorus, with the view thus to obtain the chloride $CHCl_2—CHCl_2$; but this was not the result of the reaction between the two substances just named: a product was obtained which boils at 250°, and which, on being submitted to elementary organic analysis, gave results leading to the formula $C_4H_4Cl_6O$. The constitution of this substance is apparently that of an ethyliden-oxychloride, the composition of which is to be indicated by either of the two following formulæ:—

$$CHCl_2—CH_2—O—CCl_2—CHCl_2.$$

or by—

$$CHCl_2—CHCl—O—CHCl—CHCl_2.$$

The substance, $C_4H_4Cl_6O$, is a somewhat coloured oil, heavier than water, soluble in alcohol and ether, boiling at 250°, and giving off very irritating acid fumes; on being mixed with an alcoholic solution of caustic potassa, a very violent reaction ensues, and, on addition of water, an aromatic-smelling oil is separated, which boils at 196°, and has the formula $C_4H_2Cl_4O$. This substance combines readily with bromine, forming a solid crystalline substance fusing at 60°, and having for its formula $C_4H_2Cl_4Br_4O$. Dichloraldehyde is not readily oxidised; when its vapour, mixed with air, is passed through a tube containing spongy platinum, no perceptible change ensues; mixed with its own bulk of red fuming nitric acid, a very energetic reaction sets in; when this has somewhat subsided, and the excess of nitric has been expelled by evaporation, and the residue is submitted to distillation and rectification, dichloracetic acid is obtained, which boils at about 195°, and yields, when distilled with a mixture of concentrated sulphuric acid and alcohol of 90 per cent, pure dichloracetic ether boiling at 155°.

Crystallised Digitaline.—M. Nativelle.—This alkaloid is obtained in crystalline state in the following manner:—100 parts, by weight, of coarsely-powdered *herba digitalis* is mixed with a solution of 25 parts of acetate of lead in 100 parts of water, left standing for twelve hours, and then exhausted with water; the residue is treated with alcohol of 50° until the solution thereof is free from any taste. The solution thus obtained is treated with a solution (aqueous) of four parts of acetate of lead, and filtered. To this filtrate is next added a solution of two parts of phosphate of soda, again filtered, and the alcohol removed by distillation on a water-bath. It will be observed that, in the residue of the distillation, there are suspended, in the aqueous fluid, small crystals, surrounded by a yellowish-coloured, very bitter-tasted substance. The residue of the distillation is concentrated, by evaporation on a water-bath to about ten parts, next filtered, washed with cold water, the precipitate dried by pressing it between folds of filtering paper, dissolved in about twice its weight of alcohol of 60 per cent, and put by in a cool place. While thus standing, two different sets of crystals are separated—first, those of an inactive substance; next, after some days, yellowish-coloured crystals of digitaline. After these have been fully formed, the mother liquor is run off, and the crystalline mass is taken up with alcohol of 80 per cent, while, at the same time, some animal charcoal is added The solution, having been filtered and left to evaporate, is treated with pure chloroform, and strongly shaken up with it; the digitaline only is dissolved. On distilling off the chloroform, a somewhat coloured digitaline is obtained, which is further purified by repeated treatment with alcohol and animal charcoal. The crystalline digitaline is a neutral, non-nitrogenous, inodourous substance, of very bitter taste readily soluble in chloroform, while one part of this digitaline requires twelve parts of alcohol of 90 per cent for its solution at the ordinary temperature; it is slightly more soluble in boiling alcohol, but far less soluble in absolute alcohol and in pure ether, and, practically, entirely insoluble in water at any temperature. Sulphuric acid dissolves this substance, yielding a greenish-coloured solution, which, on contact of vapours of bromine, becomes *groseille* red coloured; but addition of water restores the original green colour. Hydrochloric acid, also, dissolves digitaline, exhibiting, likewise, a green solution, from which water precipitates a resinous matter. The result of the elementary organic analysis of digitaline led to the formula $C_{25}H_{40}O_{15}$. The other crystalline substance above mentioned is insoluble in chloroform, soluble in alcohol; crystallises in colourless needle-shaped crystals which are devoid of taste, neutral to test papers, free from nitrogen, less soluble in alcohol than digitaline, and practically insoluble in water and ether. With sulphuric acid, this substance yields a *groseille* red coloured solution, which turns yellow on addition of water; nitric acid dissolves this substance to a colourless fluid, while hydrochloric acid is hardly capable of dissolving it at all. There is no elementary organic analysis as yet made of this substance, but it has been ascertained to be free from nitrogen.

Polytechnisches Journal von Dingler, first number for July, 1869.

This number contains the following original papers:—

On Stoves suitably constructed to Burn Coal as Fuel for Heating Rooms in Dwelling-Houses.—M. W. Hohbach.—The author describes, at length, an excellently arranged stove, by the use of which economy of fuel and proper supply of fresh air to the room are secured. A stove of medium size is so arranged that with from 15 to 20 lbs. of coal, a room of 12,000 cubic feet capacity is kept heated to 16° Réaumur (=20° C., and 68° F.) for from eight to twelve hours. The construction of this stove could not be well understood without the reproduction of the engravings accompanying the original.

Chemical Composition of Native Chrome Iron Ore.—M. Clouet.—After referring to the kinds of rock wherein this ore occurs, the author states that all varieties of chrome iron ore which have been hitherto analysed exhibit a constant and definite chemical composition. As instances, he quotes the following analysis:—$FeOCr_2O_3$, Russian ore, as, also, Smyrna and Norway (Drontheim); $2FeO,Cr_2O_3$, Ile à Vaches, St. Domingo; $2FeO,3Cr_2O_3$, Russia (another district); $4FeO,5Cr_2O_3$, the Banat (Alt-Orsowa); $8FeO,5Cr_2O_3$, India; $6FeO,5Cr_2O_3$, California; $3FeO,2Cr_2O_3$, Australia. A sample of pure crystalline octrahedrical ore from the Ile à Vaches was found by the author to consist, in 100 parts, of—Oxide of chromium, 51·53; protoxide of iron, 48·46. Formula, $2FeO,Cr_2O_3$. The author enters, at great length, into particulars about the analysis of chrome iron ores; but, since any good treatise on analytical chemistry may be consulted on this subject, we do not notice this part of his paper here any further.

Manufacture of Hyposulphite of Soda from Soda Waste.—M. Schaftner.—This paper is entirely a lengthy description of a manufacturing process on the large scale. The main facts are—that, to the soda waste, sulphate of soda is added; and, after this mixture has been exposed for some time to the influence of the air, it is lixiviated with water. Sulphur is obtained as a by-product.

Contribution to our Knowledge of the Relation of Carbon to Oxygen.—Dr. Richters.—This paper is far too lengthy for any useful abstraction. The chief point thoroughly elucidated by the author is the oxidation of coal, charcoal, and coke at comparatively low temperatures.

On Balata.—M. Sperlich.—Balata is the inspissated milk-juice of the *Sapota muelleri*, a tree met with in large numbers in the three Guianas. Balata appears to hold a middle place between caoutchouc and gutta-percha. The author obtained the raw material, and, after having first

treated it with boiling acidulated water, next with absolute alcohol, he dried the substance, and next dissolved it, with the aid of gentle heat, in sulphide of carbon. After removing that fluid by distillation, the balata was repeatedly boiled with a mixture of ether and alcohol, well dried and submitted to elementary analysis, yielding, in 100 parts, 88·49 of carbon and 11·37 of hydrogen, and, therefore, pretty nearly the composition of purified gutta-percha, which gives 87·91 of carbon, and 11·94 of hydrogen.

Use of Maize (Indian Corn) for Distillation of Spirits in Hungary.—Dr. Schultze.—This paper is chiefly written for distillers. The use of maize is a good idea. Curiously enough, experience appears to have taught that this grain requires, after having been ground to meal, to be steeped for about twenty-four hours in water containing sulphurous acid gas in solution. The next operation is the boiling of the meal, after which it is, when sufficiently cool, mixed with green barley malt. The quantity of spirits obtained from this material is large, and the quality good.

Alloys for Bells.—M. Lichtenberger.—It appears that for some time there have been met, in the trade in Germany, clock-bells of excellent and loud silvery tone; the author of this paper was induced, therefore, to analyse—(1) the metal the bell of a large-sized house-clock is made of, (2) a smaller bell, (3) bells for horse-harness, and (4) an ordinary small yellow-metal bell; the results are as follows:—

	No. 1.	No. 2.	No. 3.	No. 4.
Copper.....	83·22	83·09	84·50	79·90
Tin.....	16·76	16·80	15·42	20·03

The Nos. 1 to 3 are from the same manufactory.

New Method of Bleaching Feathers.—M. Duflot.—This process is an entirely newly-discovered one, whereby the feathers of ostriches and other birds may be bleached, even if these feathers are naturally black or dark grey-coloured. The feathers are placed for from three to four hours in a tepid dilute solution of bichromate of potassa, to which, cautiously, some nitric acid has been added. After this lapse of time, the feathers will be found to have assumed a greenish hue, owing to the oxide of chromium precipitated on the substance; in order to remove this, the feathers are placed in a dilute solution of sulphurous acid in water, whereby the feathers become perfectly white and bleached. Care is to be taken that the solution of bichromate be not made too strong, and, especially, that not too much nitric acid be used, which would cause an irremovable yellow colour.

Annales du Génie Civil, July, 1869.

This number does not contain any papers or communications relative to chemistry, but we learn from it the—

Abolition of Patents for Inventions in the Netherlands.—A law has been made cancelling the old patent law of 1817; and, though all existing patents remain in force, no new ones are to be any more granted from and after the 1st day of August, 1869.

Moniteur Scientifique, August 1, 1869.

This number contains the following original papers:—

On the Cooling Down of the Sun.—M. Lecoq.—This is a very lengthy, and rather speculative treatise on a subject partly belonging to astronomy, and partly to physical geography. The author deserves great credit for the lucid manner of his exposition; but we cannot enter into details on this matter, however interesting it may be.

Quantity of Heat Developed in Interrupted Electric and Galvanic Currents.—MM. Jamin and Roger.—A purely mathematico-physical paper.

On Toluol and the Alkaloid it Yields.—M. Rosenstiehl.—The greater part of the contents of this paper have been previously published, and have been quoted by us from another periodical; but we translate the last few lines of this publication for the practical value therein contained:—"Toluol is a unique and peculiar hydrocarbon, which, on being treated with nitric acid, yields, simultaneously, two nitro-derivatives (the manufacturer who desires to obtain alkaloids, in order to prepare therewith colouring matters, should take care to produce as little crystallised nitrotoluol as possible). The isomerism manifested after the action of nitric acid is maintained in its coloured derivatives. Although the two toluodines differ, as regards their chemical properties, they yield colouring matters the physical properties of which are identical. The fact of the existence of isomerism of the artificial colouring substances explains the large number of varied blue and violet matters obtained from fuchsine; this may lead to the discovery of a large number of isomers of one and the same colour; and this subject I intend to take up, experimentally, within a short time.

Fusible Alloys.—M. Stewart mixes 7·5 parts of bismuth, 4 of lead, 1·5 of tin, and 2 of cadmium, and thus produces an alloy fusing at 66°. We quote hereunder the composition of divers fusible alloys, respectively, so made that the quantity of bismuth of each is the same:—

	Newton's Alloy.	D'Arcet's Alloy.	Pelouze's Alloy.	Wood's Alloy.
Bismuth.....	600	600	600	600
Lead.....	375	300	360	320
Tin.....	225	300	240	160
Cadmium.....	—	—	—	120
	1200	1200	1200	1200

All these alloys fuse below 100°.

Under the title of—

What is Going on in Germany, we find in this periodical an excellent account briefly summarising the history, progress, and present state of the Prussian universities. The most ancient of these is that of Griefswald, founded in the year 1456; the youngest is Bonn, founded in 1818. Leaving the Austrian dominions altogether out of the question, Germany, that is to say, the North German Confederation and the Southern Independent German States, contain together 19 universities, with 773 ordinary, and 340 extraordinary professors, and 342 repetitors, and, collectively, frequented by an average of 14,383 students. Some of these institutions have large revenues; foremost among these is Tübingen, Würtemberg, with an annual revenue of 100,000 florins (about £10,000). All of these universities are under government control, and the expenses are met by regular grants made with great liberality. The population of this portion of Germany amounts to about 36,000,000, and the area, in German geographical square miles, amounts to about 10,000.

Comptes Rendus des Séances de l'Académie des Sciences, vol. lxix., No. 6, August 9, 1869.

This number contains the following papers and communications:—

Evaporation of Water by Plants.—M. Dehérain.—The author states—(1) the evaporation of water from the leaves of plants is a function entirely different from the evaporation of the same fluid from a not living (inert) surface, since the evaporation from leaves of plants is not interrupted by the state of saturation of the atmosphere; (2) this evaporation is especially due to the action of light; (3) those rays of light which are most effectual in aiding the decomposition of carbonic acid by the leaves are also those which chiefly assist the evaporation of water therefrom.

Non-Poisonousness of Coralline.—M. Guyot.—This paper contains the results of an exhaustive series of experiments by which it is fully proved that coralline, neither when taken internally even in large doses nor also when brought directly into the blood, is a poison, and that its use

[English Edition, Vol. XX., No. 508, page 96; No. 509, page 105.]

in dyeing is not dangerous, provided, at the same time poisonous substances are avoided.

Some Phenomena of Decomposition Produced by Sunlight.—M. Morren.—The author, while repeating some of Professor Tyndall's experiments, but applying, instead of electric light, the bright sunlight of Marseilles's clear sky, has discovered that several inorganic substances are decomposed when a ray of sunlight is made to pass through them; among these sulphurous acid gas is enumerated, this gas being decomposed into oxygen and vapour of sulphur. This phenomenon is caused, according to the author, by a peculiar dissociation called into play by the vibratory motion of the light, which has the effect of breaking up the chemical combination; by means of spectrum analysis the author has discovered that the activity of the light in this aspect depends partly upon its colour, and partly upon the refringence and the nature of the decomposed substance. The author has also found that a thin layer of sulphate of quinine of no more than 4 or 5 m.m. thickness entirely arrests the chemical rays, as if it were a thick yellow-coloured piece of glass. The author states that the chemical effects of highly-heated platinum—for instance, the decomposition of water by that metal, are due to the accumulation of more and more refringent rays.

On the Laws which Rule the Part any Substance Plays between Two Solvents.—M. Berthelot.—This paper is, on account of the abstruseness of the subject treated of, and also because of the algebraic mode of treatment, not very well suited for abstraction with due justice to the author and the subject.

Heat Developed by the Combustion of Coal.—MM. Scheurer-Kestner and Meunier.—This paper is a continuation of a former paper on the same subject by the same authors. The coals treated are those from the Creuzot and some Belgium coals; as an instance of the composition in 100 parts of the former we quote the analysis of a sample designated anthracitic by the authors:—Water, 1·76; carbon, 87·36; hydrogen, 3·47; ash, 3·63; oxygen and nitrogen, 3·75, Belgian coal from Denain, in 100 parts—water, 1·14; carbon, 77·68; hydrogen, 4·10; oxygen and nitrogen, 10·73; ash, 6·35. The observed quantity of heat of combustion of the first-mentioned sample amounts to 9409 units; that of the last-mentioned sample amounts to 9085 units.

Succinate, Benzoate, Nitrite, and Nitrate of Isopropyl.—M. R. Silva.—The succinate of isopropyl is a liquid exhibiting an agreeable but very peculiar smell; insoluble in water, soluble in alcohol and ether, inflammable at a higher temperature, boils at 228°, its specific gravity at 0° is 1·009 and at 18° 0·997. Benzoate of isopropyl is also a liquid exhibiting a very pleasant smell; insoluble in water, but soluble in alcohol and ether; boils at 218°, its specific gravity at 0° is 1·054, at 25° 1·013. Nitrite of isopropyl is an inflammable, slightly yellow-coloured, liquid, boiling at 45°; specific gravity at 0° 0·856, and at 25° 0·844. Nitrate of isopropyl is a colourless, very inflammable liquid, boiling between 101° and 102°; specific gravity at 0° 1·054, at 19° 1·036; its vapour detonates violently when strongly heated.

Transport of Artificially-Made Ice.—M. Toselli states that a solid block of ice weighing 23 kilos., and made in 18 minutes by a process invented by him, has been sent from Paris to Algeria, and received there without more than a very trifling loss by melting during this long journey in hot summer weather.

A large number of papers and communications in this number again refer to the Newton-Pascal and Chasles Leverrier controversy.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., No. 1.

This number contains the following papers relating to chemical science:—

Evolution of Ammonia Gas from Mushrooms.—M. El. Borscow.—The author says that, many years ago, the late Professor Sachs observed that when a glass rod, moistened with dilute hydrochloric acid (specific gravity, 1·12) was brought near vigorously and healthily growing mushrooms, there appears a white vapour, evidently due to the formation of chloride of ammonium. This tact has been confirmed by Dr. G. Lehman, while the late Alexander von Humboldt stated that mushrooms constantly give off, not only ammonia, but also hydrogen. The author of this paper has thoroughly investigated this subject, taking due care to eliminate all sources of error from his experiments by every precaution modern science can suggest and successfully apply. Several engravings would be absolutely necessary for the proper understanding of these researches; but we briefly notice the following results:—(1) different kinds and species of mushrooms give off, while growing vigourously, weighable quantities of ammonia; (2) this evolution of ammonia is not confined to full-grown mushrooms only, but also to the young individuals, and even to some varieties of mushroom spawn; (3) this evolution of ammonia is a proper function of the living organism of these cryptogamic vegetables, and is very little, if at all, influenced by exterior causes; (4) there is no direct relation between the quantity of ammonia and that of carbonic acid given off during a given period of time. The quantity of ammonia given off during a certain length of time bears no direct relation to the weight of the substance from which it is given off.

Malowka Coal.—M. G. Von Helmersen.—This is a geologico-mineralogical account of researches made in the Tula-Kalugaer coal district, Ural Mountains, Russia. Although the coal seam here alluded to is not suitable for working, its discovery is remarkable on account of its occurrence in the so-called Devonian system, wherein coal seams have not been hitherto found. The author does not speak of the quality of this coal, nor does he give any account of its physical or chemical properties. The paper enumerates the layers and thickness of the various kinds of rocks bored through for other mining purposes, when accidentally this coal was found.

Influence of Temperature upon the Capacity of some Metals for Conducting Heat.—M. Lenz.—The results of the author's experiments may be briefly stated. (1) the capability of conducting heat and electricity are proportional to each other when the temperature is the same; (2) the influence of temperature upon the capability of conducting electricity and heat is the same. In this point the author's results differ from those obtained by Messrs. Angström and Forbes.

On Urinylic Acid.—Dr. N. Sokoloff.—The author made nitrous acid gas pass through a mixture of 100 grms. uric acid and 300 c.c. of water at 70°; a very tumultuous reaction took place, and a large quantity of carbonic acid and nitrogen gases was evolved. The chief result of this reaction is the formation of a new acid, which the author calls urinylic acid, $C_8H_7N_7O_6$; it is a tribasic acid. The alkaline salts of this acid are very readily soluble and crystallise; the lime and baryta salts are insoluble in water and insoluble also in acetic acid; the urinylic acid itself is a yellow-coloured, strongly acid-reacting crystalline powder, difficultly soluble in water. When this acid is heated with nitric acid (specific gravity 1·30) and care taken to avoid further heating after the acid is dissolved, there is deposited from the fluid, on cooling, a new acid crystallising in needle-shaped crystals and converted by nitrous acid into a substance akin to alloxantin, but not further investigated by the author.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, April, 1869.

Among a series of essays and papers read at the meetings of this society, we find the following communications relating to chemistry:—

On the Substances which agree with (entsprechen) Essential Oil of Mustard and are Isomeric with Hydrosulpho-cyanic Ether.—Dr. A. W. Hofmann.—The author first briefly refers to a former paper on this subject, wherein he treated on the combined action of water and a high temperature upon the essential oil of mustard; he next states that when, instead of water, alcohol is made to act at a temperature of from 110° to 120°, the ether of a peculiar acid is readily obtained. The author, dividing his subject into several sections, treats—(1) on the action of ethyl alcohol on *ethylsenföl* (ethylated essential oil of mustard); (2) on the action of ethylmercaptan upon ethylcyanide; (3) action of ethylmercaptan upon *ethylsenföl;* (4) action of alcohol upon *allylsenfol* (allylated-essential oil of mustard); (5) action of alcohol upon *phenylsenfol* (phenylated essential oil of mustard); (6) action of ethylmercaptan upon phenylsenföl. We regret that, with due justice to the contents of this lengthy essay and its eminent author, we cannot enter into more details on this subject.

Contribution to our Knowledge of Methyl-Aldehyde.—Dr. A. W. Hofmann.—The author first briefly reviews his former communications to the Academy on this subject; he next refers to the labours of MM. Aimé Girard, Geuther, and Butlerow, and discusses the question whether the substance called dioxymethylen by M. Butlerow, is identical with the methyl-aldehyde directly obtained from methyl-alcohol (pure wood spirit) when its vapours are carried along with air over a red-hot platinum wire, placed in a combustion tube. The author states that dioxymethylen, which fuses at 152°, and boils at a higher temperature, cannot be considered to be the normal methyl-aldehyde, CH_2O. The author's paper is chiefly written with the view of elucidating the true bearing and relation of normal methyl-aldehyde towards other compounds which are either polymeric or isomeric with it. The paper is too lengthy and too concisely written to admit of more abstraction.

Polytechnisches Journal von Dingler, second number for July, 1869.

This number contains the following original papers:—

Researches on the Necessity of Water Supply to the Vital Functions of the Yeast Cells.—M. Wiesner.—The quantity of water contained in the living yeast cells varies from 0 to 80 per cent, but it appears that the proper functions of these minute organisms do not begin to be exerted unless they contain at least 13 per cent of water, and the greatest activity of these cells requires undoubtedly 40 per cent of water. When water is gradually withdrawn from these cells, either by drying under a desiccator, or even by a slowly rising temperature up to 100°, their vital activity is not thereby destroyed or impaired. Yeast containing only 13 per cent of water induces, in fluids containing from 10 to 20 per cent of sugar, fermentation as intensely as yeast which contains from 70 to 80 per cent of water; alcohol kills yeast, *i. e.*, impairs its capability of inducing fermentation by rapidly withdrawing the water necessary to the existence of the yeast cells. Too concentrated solutions of sugar act upon the yeast cells in the same way, and hence no fermentation can take place therein.

China Grass.—M. Unger.—This material, or fibre, is obtained from the *Urtica Nivea*, L. It is akin to cotton made up of single cells; the diameter of the fibre averages 0·05 m.m.; in air dried state this substance contains 6·52 per cent of water, but if the material is left for twenty-four hours at 20° in a space saturated with aqueous vapour, the quantity of water increases to 18·15 per cent; the quantity of ash of the dried fibre amounts to 1·70 per cent.

Peru Gum.—M. Beckerhinn.—Under this name there is brought into commerce a powder, which, according to the researches of this author, consists almost entirely of small particles possessing, when seen under the microscope, an organised texture. This texture appears to be entirely soluble in water; chemical examination of this substance gave the following results for 100 parts:—Water, 12·72; gum soluble in water, 24·27; substances soluble in alcohol, 48·69; soluble in ether, 4·16; insoluble in water, alcohol, and ether, 4·25; ash, 4·82.

Gum from Moringa Pterygosperma.—MM. Wiesner and Beckerhinn.—This gum was first brought to Paris in the year 1867, under the name of *gomme de ben-ailé*, from one of the French settlements in Hindostan. Its aspect is not unlike Senegal gum; in 100 parts it consists of—Water, 11·71; soluble in alcohol, 8·30; soluble in ether, 7·85; soluble in water, 24·85; insoluble in water, alcohol, ether, 43·86; ash, 1·81.

Annalen der Physik und Chemie, von Poggendorff, 1869, No. 7.

This number contains the following original papers:—

Spectra Exhibited by some Gases when Under High Pressure.—M. A. Wüllner.—This paper is the continuation of a monograph on this subject, the publishing of which commenced in this periodical two volumes back. It is an excellent essay, but, owing to its great length, is not well suited for useful abstraction.

Floating and Expansion of Liquids upon Liquids.—M. Lüdtge.—In the introduction to his essay, the author says, the first fact which gave rise to the scientific study of the phenomena observed when a drop of oil, for instance, falls on water, was that first observed by mariners, of the calming effects of oil poured on the surging waves of the sea in a severe gale of wind, a subject on which an excellent memoir was written and published many years ago by the eminent physicist, M. Van Beek. The author's essay is copiously illustrated by exquisitely executed engravings, but as it is only by the aid of these that the subject matter of this paper can be made intelligible, we must refrain from further notice of the subject.

Some New Antimony Minerals from Wolfach, Baden.—M. Petersen.—A portion of this paper is a geologico-mineralogical essay of local interest chiefly, of the following minerals, of which the chemical composition is given. *Stibiotriargenite.* Specific gravity, 9·611 to 9·770; in 100 parts—Antimony, 27·35; silver, 72·65. *Stibiohexargenite*, Ag_6Sb. In 100 parts—Antimony, 15·84; silver, 84·16. *Coarse-Grained Antimony-Silver.* In 100 parts—Antimony, 23·06; silver, 76·65. *Polyargyrite.* In 100 parts—Sulphur, 14·78; antimony, 6·98; silver, 76·70; lead, a trace; iron, 0·36; zinc, 0·30. *Wolfachite.* In 100 parts—Sulphur, 14·43; arsenic, 38·46; antimony, 13·17; lead, 1·32; silver, 0·12; iron, 3·71; nickel, 29·53; cobalt, a trace; copper and zinc, small traces.

Distances which Limit the Molecular Action of Capillarity.—M. Quincke. — A mathematico-physical essay.

Isodimorphism of Arsenious and Antimonious Acids.—M. P. Groth.—A purely crystallographico-mineralogical essay.

Crystallised Kainite Found at Stassfurth.—M. P. Groth.—This paper, also a crystallographico-mineralogical essay, is accompanied by several engravings. Kainite consists, in 100 parts, of—36·34 K_2SO_4; 25·24 $MgSO_4$; 18·95 $MgCl_2$; 19·47 H_2O.

Relation Existing Between Circular Polarisation and Hemiedric Hemisymmetry.—M. V. Von Lang.—Unsuitable for abstraction.

Feeble Electric Sparks in Air.—M. P. Reiss.

Vibrations of Luftplatten (thin layers of air).—M. Kundt.—Both these papers are mathematico-physical essays.

Cause of the Galvanic Phenomena of Cooling and Heating Observed by Peltier.—M. Edlund.

How can we Neutralise those Induction Currents which are Generated in the Electro-Magnetic Motors during the Rotation of the Movable Magnets, and Prevent these Currents Weakening the Full Action of the Machine?—Dr. Sinsteden.

Estimation of the Dispersion of Glycerine.—M. Listing.

Experiments made with Holtz's Induction Machine.—M. Schumacher.

Observation on the Treatise of M. R. Most, entitled a New Proof of the Second Law on Heat (Wärmegesetz).—All the papers of which the titles only are quoted are too abstruse for useful abstraction.

Journal de Pharmacie et de Chimie, July, 1869.

This periodical contains, in the first place, three papers which we do not quote, since the subject matter has been already alluded to, taken from the *Comptes Rendus*. The original papers are:—

Double Fluoride of Iron and Sodium.—M. Nicklès.—When a concentrated solution of sesquichloride of iron is added to a concentrated solution of fluoride of sodium, a white precipitate ensues, which disappears on the addition of the slightest excess of sesquichloride of iron. When to this last solution, tepid alcohol is added, a flocculent yellow precipitate is formed, which is also a double fluoride of iron and sodium, with excess of iron. Both these varieties give, on analysis, results which lead to the formula $2NaFl,Fe_2Fl_3,HO$.

New Reagent for Brucine.—M. Cotton.—When, to a solution of brucine in nitric acid, hydrosulphide of sulphide of sodium is added, in concentrated solution, the mixture becomes, first, violet, next green-coloured, provided the alkaloid is in excess. Morphia does not give any similar reaction under the same conditions; alkalies do not affect this colouration; dilute acids render it rose-coloured, while sulphuretted hydrogen is given off; 2 milligrms. of brucine impart, in this manner, a decided colouration, even to half a litre of water.

Recent Researches on the Essence of Roses.—M. Flückiger.—Chemically considered, the essential oil of roses, is a mixture of an oil containing oxygen, to which alone the smell and perfume is due, and a solid hydrocarbon, a stearopten absolutely devoid of smell, and composed according to the formula $C_{16}H_{16}$. This hydrocarbon is soluble in chloroform, fuses at 32°, and boils at 272°. Potassium does not act upon this substance; treated with a mixture of bichromate of potassa and sulphuric acid, it yields, faintly, a smell of acroleine; with fuming nitric acid, butyric, formic, fumaric, oxalic, valerianic, and succinic acids are formed.

New Apparatus for the Concentration of Sulphuric Acid.—M. Cotelle.—It is a well-known fact that the concentration of sulphuric acid in platinum vessels is an expensive process, owing to the high price of the first purchase of these apparatus, and the expense attending any soldering or repair. The author has had made a column, lined inside with fire-bricks, and made outside of good ordinary bricks; it rests on a large pedestal. This column is open at both top and bottom; but in these openings are fitted fire-clay stoppers. The inside of this apparatus is fitted with previously-calcined pumice-stone; inside the lower portion of this column, openings are made between the bricks, through which a current of highly-heated air is forced. From the top, the acid which has to be concentrated is made to trickle on the pumice-stone, and, meeting with a current of highly-heated air, the superfluous water is driven off, and the acid, on arriving at the bottom, is in a concentrated state, and runs off in properly-arranged vessels.

The remaining papers in this number are specially devoted to *materia medica* and sciences more closely connected with medicine.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, 1869, No. 11.

This number contains the report of the meeting of this society, held on the 14th of June last. It appears that this society's membership is highly valued beyond Prussia, since no less than nine new foreign members were admitted at this meeting; the following papers were read:—

On Halhydrate Water.—M. Erlenmeyer.—The author says that, many years ago, Dr. T. Graham called attention to the fact that the sulphates of magnesia, of oxide of zinc, of protoxide of iron, of oxide of copper, and the sulphates of the protoxides of nickel and cobalt, contain, besides water of crystallisation, a certain quantity of water, which belongs to, and is essentially required for, their constitution. Professor Graham called it *basic water*, and stated that it could be replaced by salts; at a somewhat later period (now, however, nearly forty years ago) the same *savant* named this water *salinic*, and distinguished between it and *basic water*, inasmuch as for the former may be substituted salts, for the latter bases. Since the year 1838, Professor Dr. J. Von Liebig has called that water contained in salts for which, according to Professor Graham, may be substituted equivalents of other neutral salts, *halhydrate water*. The author of this paper is of opinion that modern chemists have altogether forgotten this matter, and especially since it might inconvenience their mode of representing things; there exists, however, for all that, a great distinction between water of crystallisation and halhydrate water, and the author having carefully studied this point, has come to the conclusion, on theoretical as well as on experimentally proved facts, that the salts which contain halhydrate water are not neutral salts in the ordinary sense of the word, but acid salts in one way, and basic salts in another way—that is to say, they are salts which contain at the base, as well as at the acid, *hydroxyls*, which have not yet reached the formation of anhydride (neutralisation). The author gives instances of his mode of representing this matter, and states that he will shortly publish extensive researches on this subject.

On Betain, a New Vegetable Base met with in the Juice of Sugar Beet-Roots (*Beta vulgaris*).—M. C. Scheibler.—The author says, in the year 1866, he published a brief account about a vegetable base met with in the juice of the sugar beet-roots, and which base, on account of its great solubility, becomes accumulated during the sugar manufacture from beet-root juice, in the molasses which result from that process. The author has prepared this base from the freshly expressed juice of the sugar beet-root, as well as from the molasses. The process of separation is, as might be expected from the complex nature of the substances just named, very complicated, and requires the use of phosphomolybdate of soda. Since in this country there do not exist beet-root sugar works, and since large quantities of juice have to be operated upon, we do not enter into the details of preparation, but describe the new base *betaïn*. It is a solid substance, crystallising from its alcoholic solution in large crystals, which are very deliquescent, and contain water of crystallisation, which they lose by drying at 100° or over strong sulphuric acid; the base is very soluble in water, its solution saturated at 25°, has a specific gravity of 1·1177, and then contains 61·8 per cent of the anhydrous base. Betain does not affect vegetable colours, is void of smell, and has a sweetish cooling taste. The result of the elementary organic analysis of betain dried and fully deprived of all water led to the formula $C_5H_{11}NO_2$; the crystalline air-dried substance has the formula $C_5H_{11}NO_2 + H_2O$. This base yields, with many acids, beautifully crystallised salts, and readily forms well-crystallised double salts with the chlorides of gold and platinum, mercury, cadmium, and zinc. When betaïn is boiled with an aqueous solution of caustic potassa, it is thereby split up into several bases, among which trimethylamin is found. Oxidation of betain by means of chromic acid and the action of strong hydriodic acid, both tried in

sealed tubes, led to no results of any value. Betain resists the oxidising action of chromic acid.

Contribution to the Mode of the Analysis of the Gold and Platinum Salts of Organic Bases.—M. C. Scheibler.—The author dissolves a weighed quantity of the gold or platinum salt in water, or if it does not happen to be readily soluble therein, keeps it suspended therein, and places it in contract with metallic magnesium, whereby the metals gold and platinum are separated, and hydrogen is at the same time evolved. This operation is carried on at the ordinary temperature, or if the salts are difficultly soluble, on a water-bath; the fluid may be acidified, but not with hydrochloric acid, since the object often may be to estimate chlorine also. The ribbon-like magnesium wire met with in commerce is sufficiently pure for this purpose. The gold and platinum separated during this operation are, by means of careful decantation, freed from the fluid wherein they are immersed, and next transferred to a filter and washed, first with distilled water and next, after the filtrates intended for the estimation of chlorine have been set aside, with dilute hydrochloric acid, in order thereby to remove any excess of magnesium or any magnesia which might remain mixed with, or adhered to, these metals; after having been well purified and dried, the metals are ignited and weighed. The results obtained by this method are very correct.

Occurrence in the Molasses of Beet-Root Sugar of a New Acid Homologous with Asparaginic Acid.—M. C. Scheibler.—This is, as the author states, only a preliminary notice. He says some three years ago, he was occupied in experimenting on the preparation of asparagin, which, according to M. Rossignon's statement, is met with in freshly expressed sugar beet-root juice in quantities varying between 2 and 3 per cent. The author of this paper did not then discover asparagin, but instead thereof he found asparaginic acid; this acid, however, on more close examination, proved to be not the asparaginic acid itself, but an homologue thereof, to which, according to analysis, the formula $C_5H_9NO_4$ belongs. The author further states that he is not as yet enabled precisely to say whether the substance in question is really an homologue of asparaginic acid, or whether it is perhaps only a methylated asparaginic acid—

$$C_2H_3 \left[\begin{matrix} CH_3 \\ H \end{matrix}\right\} N \Big]_2O\ H_2$$

On a Di-carbonic Acid of Sulphur.—M. V. Meyer.—The author of this paper, after entering into some merely speculative discussion, states that he has succeeded in preparing dicarbonthionic ethyl ether, a colourless oily fluid, exhibiting a very characteristic but not very strong smell, boiling at 180°, but not entirely volatile without undergoing decomposition. The dicarbonthionic acid is unknown in free state; the researches on this subject are continued by the author.

Variable Vapour Densities.—M. Aug. Horstmann.—This paper will not admit of proper abstraction with due justice to the subject and the author, a remark which equally applies to the next paper.

Contribution to our Knowledge of Molecular Compounds.—M. Wichelhaus.

A New and General Method for the Formation of Nitriles.—M. Henry.—The author of this paper communicates a series of experiments made by him with the view to prove "that the amides, when acted upon by pentasulphide of phosphorus, are readily converted into nitriles, while at the same time sulphuretted hydrogen and anhydrous phosphoric acid are formed." The author describes at great length his experiments with acetamide, benzamide, and oxamide, and in each case nitriles are formed with more or less readiness, and accompanied with a larger or smaller quantity of by-products.

On Parachlorotoluidine.—MM. Henry and Radziszewsky.—Parachlorotolnidine, $C_7H_6ClNH_2$, prepared by the authors by means of a rather complicated process from para-chloronitrotolnol, exhibits an oily strongly refractive liquid, the odour of which is akin to that of toluidine; its specific gravity at 18° is 1·175; boils at 236°; combines readily with hydrochloric, sulphuric, and nitric acids, forming therewith solid crystalline compounds. The authors state that this communication is only preliminary, and that their researches on this subject are not yet quite finished.

On Bismuth Silver.—M. Kayser.—When molten bismuth begins to solidify, the well-known phenomenon of the expulsion of a portion of the yet fluid metal from the interior of the partly fluid mass is observed in consequence of the fact that the solidified metal is specifically lighter than the molten and fluid metal; admixture of other metals, while impeding the crystallisation of the bismuth, also impede its expansion on cooling, but all metals do not act in this respect alike, for the addition of about 10 per cent of lead to bismuth entirely prevents its expansion. An alloy of silver and bismuth behaves in a different manner. The author, while working with silver on the large scale, accidentally obtained an alloy of the former metal and bismuth consisting, in 100 parts, of Bi, 56·1; Ag, 43·5. Upon the surface of this alloy were observed a large number of spherical particles of bismuth, measuring from 5 to 10 millimetres diameter, and consisting, in 100 parts, of Bi, 97·6; Ag, 2·355. While the operation of cupellation was being continued and the quantity of silver rose to 60, 70, and 80 per cent, the globules of bismuth expelled contained invariably 2·5 per cent of silver.

On Crystallised Phosphoric Acid.—M. Krämer.—When an aqueous solution of phosphoric acid, the specific gravity of which has been ascertained, and which solution consequently contains a known quantity of water, is so concentrated by evaporation that the remaining acid exactly corresponds to the formula H_3PO_4, this solution, on cooling, solidifies, yielding beautifully prismatic crystals of pure phosphoric acid.

On the Stilben Series.—MM. Limpricht and Schwaner state that the insinuation made against their researches on this subject, and especially the statement made by M. Grimaux, that his communication, on this subject made in 1867 in the *Bulletin de la Société Chimique de Paris*, has been made improper use of by the authors of the paper on the above subject, recently published in this German periodical, is altogether erroneous; they vindicate their rights and priority in this notice.

A Base Homologous with Kyanæthin.—M. Bayer.—In a rather lengthy paper, the author states that he has discovered a substance which he calls kyanmethin, consisting, in 100 parts, of—Carbon, 58·50; hydrogen, 7·35; nitrogen, 34·15; formula, $C_6H_9N_3$. This substance is a crystalline solid, readily soluble in water, less readily so in alcohol and ether, fuses at about 180°, sublimes without being decomposed, forming thereby finely white-coloured needle-shaped crystals; its vapour is very irritating and excites coughing; its taste is bitter and very like that of quinine. This base combines with acids, forming readily crystallisable salts. This base is a product, among others, of the action of sodium upon aceto-nitrile. The hydrochlorate of this base is composed according to the formula $C_6H_9N_3HCl$.

Cosmos, August 7, 1869.

This number contains, among a great mass of useful information not suitable for abstraction in our columns, a paper on the—

Ripening of Grapes by Cutting away part of the Leaves.—M. J. Comté.—At a meeting of the Agricultural Society of Agen, the author called attention to a chemico-physiological fact of great importance. It appears to have been an old custom, and is yet so, to pull off from the vines, especially in the Southern parts of France, a large quantity of leaves, especially close to where the fruit is placed on the stems, so as to allow full sunlight to fall on the grapes, which, in consequence thereof, soon get an amber-yellow colour, and

appear to be rather over-ripe. The author condemns this custom; and, while citing, among the older authorities on this subject, MM. Rosier and Chaptal, he states that, as regards the grapes, the presence of the leaves, as arranged by ature, is absolutely necessary to them for perfecting their maturity, which means for converting into grape sugar a portion of the acids present in the unripe grapes in large quantity. The carbonisation (by which word the author understands the addition of carbon to the acids) is effected by he leaves, through which the vegetable juice passes, for the urpose of becoming deoxidised. Fully ripe grapes should exhibit an agreeable green colour; grapes taken from the vine before they were ripe do not reach maturity at all, as other fruit does, but remain as they were. Taking away the leaves, therefore, does not ripen, or speed the ripening of the fruit, but only alters its colour to a shade of yellow, which enuinely ripe grown grapes never present. The taste of these yellow grapes is intensely sour, while that of the green-coloured ripe grapes is extremely sweet. The author regrets that the foolish practice alluded to is not authoritatively prohibited, on sanitary grounds, and for the reason that it is very injurious to the fruit-bearing of vineyards.

Levels of Two Seas.—M. Faye.—As a proof of the correctness of the geodesical survey made in 1798, during the celebrated Egyptian campaign, it may be stated that the author, on re-calculating the results then obtained for the difference in level between the Mediterranean and Red Seas, and comparing the results with those obtained when a survey for the construction of the Suez Canal was made in our time, found the results to be—0 85 metre for 1798, and 0·86 metre for 1866.

Influence of the Intensity of Coloured Light on the Quantity of Gas Set Free by Plants.—M. Prilleux.—It is well known that, under the influence of direct sunlight, the green-coloured parts of plants decompose carbonic acid. The author, in order to learn the effect of rays of light of equal intensity, has applied coloured solutions which could be rendered more or less deep coloured by adding thereto dye-stuffs, while the intensity of the light was photometrically measured. In the midst of these coloured aqueous solutions, branches of aquatic plants were placed in large glasses filled with water saturated with carbonic acid. The undermentioned figures denote the activity of decomposition of carbonic acid for two kinds of aquatic plants thus exposed during one minute of time. No. 1 refers to the *Potamogeton perfoliatus*, Nos. 2 and 3 to *Elodea canadensis*.

White light.....	64·75	74·5	51·36
Blue light.....	56·00	58·8	52 92
Orange light.....	55·30	57·0	38·00

There may, therefore, be deduced from these experiments that the differently coloured lights do also act differently upon the green parts of plants, and call forth an equal disengagement of oxygen, when the intensity of the light remains the same, and, consequently, all the rays of the solar spectrum cause the decomposition of carbonic acid by plants.

August 14, 1869.

For those interested in very speculative matters, we men tion that this number contains, as did a preceding, and as will, in all probability, one or more of the next numbers, an article on the—

Means of Communication between our Earth and the Planets.—M. C. Cros.—We do not enter into the details, as they do not belong to the domain of chemistry or the sciences more immediately connected therewith.

Les Mondes, August 5, 1869.

We quote from this paper the following :—

Chemical Laboratory at Neufchatel.—This well-known, beautifully-situated little Swiss town, with a population of about 11,000, has obtained an excellently well-arranged chemical laboratory, placed under the direction of Dr. Sacc. There is ample room provided for forty students to work comfortably, and provided with all useful instruments. The building contains lecture-rooms, and every other requisite. The town possesses excellent educational establishments, and is a very healthy place.

Manufacture of Various Objects from Quills.—M. Clerget.—While the southern parts of France, only a few hundred miles distant by rail from Paris, could throw into the trade large quantities of excellent material (home produced), the cost of transport by rail from Toulouse to Paris, for the same weight and bulk, is only two francs less than the enormously long and circuitous journey from Kasan and Nijni-Novgorod to Paris. The article in question, not being one subject to deterioration, requires, of course, no great speed in conveyance. The quills and feathers are sorted; the smallest are used for ornamenting toys, while the better quills are turned into tooth-picks, and nibs for writing purposes, and almost all the rest, except the pith, is used in ornamental-flower making, brush-making, and imitation of horse-hair work. The feathers have recently been woven into a tissue fit for use as carpets, by means of machinery invented by M. Bardin, the owner of the works inspected by the above-named gentleman officially, to see that all hygienic measures are duly carried out.

Researches on the Illumination of Liquids by means of a Beam of Neutral or Polarised Light.—M. Lallemand.—The author describes minutely in this paper a series of minute optical experiments with liquids suitably held in tubes. When a beam of sunlight is made to illuminate different liquids, there are observed various phenomena dependent upon the substance employed, or under observation. In this aspect, liquids are divided into three categories—(1) some do not possess any perceptible fluorescence, and are devoid of rotatory power; (2) they possess more or less fluorescence, and, akin to the first, are devoid of all rotatory power; (3) these fluids have rotatory power, and exhibit, in addition thereto, often a very strong fluorescence. To the first class belong, among other liquids, water, nitric and hydrochloric acids, and liquid ammonia. Samples of second class—Solutions in pure water of salts of quinine, also esculine, and, among pure liquids, perfectly chemically-pure sulphide of carbon. Third class—A concentrated solution of pure cane-sugar may serve as examples.

Comptes Rendus des Séances de l'Académie des Sciences, August 23, 1869.

This number contains the following memoirs and communications bearing more especially upon chemistry :—

Researches on the Ethereal Derivatives from Propylic Alcohol.—MM. Pierre and Puchot.—Iodide of propyl, prepared by the reaction of phosphorus upon a mixture of pure propylic alcohol and iodine, exhibits, after repeated purification, a colourless liquid, having a sweetish, somewhat alliaceous odour, boiling at 104·5°; sp. gr., 1·784 at 0°. When this fluid is exposed to air, it is slowly decomposed, and iodine is set free.—Valerianate of propyl, prepared by distilling a mixture of pure propylic alcohol, pure valerianate of potassa, previously dried, and sulphuric acid, very cautiously and gradually added to the mixture, is, after having been purified, a colourless liquid, boiling at 157°; sp. gr. at 0°, 0·887.—Butyrate of propyl, $C_8H_7O_2$, C_6H_7O, is obtained by the very cautious distillation of a mixture of previously-dried butyrate of potassa, propylic alcohol, and sulphuric acid. After repeated rectification, a fluid is obtained which boils at 137·25°, is colourless, and exhales the odour of fruit and herb of mint, mixed; sp. gr. at 0°, 0·888.—Acetate of propyl, $C_4H_3O_3,C_6H_7O$, is prepared by distilling a mixture of propylic alcohol, dried acetate of soda, and sulphuric acid. After repeated rectifications, a very limpid, colourless, agreeably-smelling liquid is obtained, boiling at 103°. Sp. gr. at 0°, 0·910.—Formiate of propyl, C_2HO_3,C_6H_7O. After rectification, a liquid is obtained

boiling at about 83°. Sp. gr. at 0°, 0·9197.—Propionate of butyl, $C_6H_5O_3,C_5H_9O$, is obtained by distilling a mixture of previously-dried propionate of potassa, butylic alcohol, and sulphuric acid, after repeated distillation and rectification of the raw liquid first obtained. The pure ether is a very fluid, colourless, agreeably-smelling liquid, boiling at 135·7°. Sp. gr. at 0°, 0·8934.—Propionate of ethyl, $C_6H_5O_3,C_4H_5O$, obtained by distilling a mixture of previously-dried propionate of potassa, pure strong alcohol (95 per cent), and sulphuric acid. The purified liquid boils at 100°; its odour is somewhat akin to that of acetic ether. Sp. gr. at 0°, 0·9137.

The Metrical System.—M. J. Dumas.—The report of the committee on this subject, of which this eminent *savant* is the spokesman, reviews the labours of a very select committee of eminent men, representing not only France, but also Switzerland and Holland, who commenced their work in the year 1790, and finished it on the 4th of Messidor, of the year VII. (23rd of June, A.D. 1800). The present committee recommends that the standards of weights and measures in the custody of the Academy shall on no account whatever be altered or tampered with in any way. Since these standards have been made and verified by an international committee of *savants*, and every care was taken to ensure the perfection of these standards, the committee also recommend that the French government shall give permission to delegates of foreign nations to get copies made of the standards alluded to under proper supervision, and that these delegates do take what care they deem proper to ensure correctness of these copies.

Manufacture of Special Kinds of Pig-Iron.—M. Jordan.—This is a metallurgical memoir, wherein the author discusses the calorific phenomena produced by the injection of jets of air, steam, or oxygen into molten cast-iron. The tendency of this paper is entirely practical, and it is, moreover, too lengthy for useful abstraction.

Chloride of Acetylen and the Synthesis of Julin's Chloride.—MM. Berthelot and Jungfleisch.—Instead of making chlorine in free state act upon acetylen, the authors have applied chloride of antimony, by which acetylen is rapidly absorbed, so much so, that, owing to the strong heat which is developed, the mixture has to be cooled. A compound of equal equivalents of perchloride of antimony and of acetylen is obtained, $C_4H_2SbCl_5$. This body is instantaneously decomposed by water; and when gently heated, it is split up into protochloride of acetylen and protochloride of antimony—

$$C_4H_2.SbCl_5 = C_4H_2Cl_2 + SbCl_3.$$

The protochloride of acetylen is a colourless liquid; it smells like chloroform; boils at 55°; moist air slowly decomposes it; heated in sealed tubes to 360°, it is decomposed, carbon deposited, and hydrochloric acid formed. Perchloride of acetylen, $C_4H_2Cl_4$, is also a liquid, boiling at 147°. When this substance is poured into a bottle filled with chlorine gas, it is converted into sesquichloride of carbon, C_4Cl_6; heated to 300° in a sealed tube during fifteen hours, this perchloride is converted into chlorinated protochloride of acetylen and hydrochloric acid—

$$C_4H_2Cl_4 = C_4HCl.Cl_2 + HCl.$$

When the temperature is raised to 360°, and continued for 100 hours, the perchloride of acetylen is converted into the so-called chloride of Julin, which is identical with perchlorinated benzine, and hydrochloric acid—

$$3C_4H_2Cl_4 = C_{12}Cl_6 + 6HCl.$$

Les Mondes, August 12, 1869.

From this number we abstract:—

Electric Light.—The editor learns, with great pleasure, that the directors of the Transatlantic French Steam Navigation Company have entered into a contract for supplying, to their vessels, magneto-electric machines and other requisite apparatus for exhibiting on board during the night-time electric lights as signal-lamps. The superiority of the light is manifest. It need hardly be pointed out that, by adopting this mode of illumination, the directors of the aforesaid Steam Navigation Company greatly increase the safety of their vessels. Electric light ought to be more generally used for this purpose.

New Mode of Gas-Lighting.—M. Boital.—Although no particulars are as yet given, it appears, from a short notice in this paper, that the party just named has established a gaswork, capable of supplying 600 burners on a square surface of no more than 12 square metres. The gas produced is of excellent quality, and the price of making the requisite works, as well as the gas produced, is very low.

This number contains a lengthy paper, illustrated with woodcuts, on the—

Manufacture of Soda-Water-Making Machines and other Machinery.—We only name the title; parties interested will do well to consult the original, which is full of excellent and useful information on this matter.

Journal fur Praktische Chemie, No. 10, 1869.

This number contains the following original essays and papers:—

Experiments on the Salts of the Cerium Bases.—M. H. Zschiesche.—The author of this essay treats, under separate headings:—1st. *Lanthanum Compounds.*—The oxide of lanthanum was obtained by strong and long-continued heating of the oxalate of that base. So obtained, it constitutes a pale red powder, which readily attracts carbonic acid from the air, thereby changing into a bright white-coloured carbonate of lanthanum. The oxide is readily soluble in acids, yielding therewith absolutely colourless salts. Oxalic acid, or better still, oxalate of ammonia, precipitates oxalate of oxide of lanthanum from its neutral or slightly acid solutions, but an addition of ammonia is required for complete precipitation. The oxide of lanthanum is readily soluble in hydrochloric acid, yielding therewith chloride of lanthanum; the neutral chloride crystallises in large non-deliquescent crystals containing five atoms of water. 2nd. *Didymium Compounds.*—The oxide was obtained, as that of lanthanum, by a long-continued and strong ignition of the oxalate; the colour of the oxide so obtained is bright ash-grey. The sulphate of the oxide of didymium is obtained by dissolving the ignited oxalate in sulphuric acid; the excess of that acid is removed by evaporation, the saline mass dissolved in water: and, after concentration of the solution on a water-bath, crystals are obtained exhibiting the colour often exhibited by sulphate of manganese. The author applied this salt to the estimation of the atomic weight of the oxide of didymium, which he found equal to 54·585. Chloride of didymium crystallises with some difficulty, owing to the fact that this salt is very deliquescent; dried over sulphuric acid, the composition of this salt is $DiCl + 5HO$. The nitrate of oxide of didymium also crystallises, but the substance is equally deliquescent as the previously-mentioned salt. 3rd. *Compounds of Cerium.*—If we except, says the author, the combinations of oxydulo-oxide of cerium, the compounds of this element have been frequently the subject of researches. When perfectly pure oxalate of cerium is strongly ignited, there ensues a compound corresponding to the formula Ce_2O_4. When this compound is treated with strong sulphuric acid, it evolves a great deal of heat, and forms, when brought into contact with water, a deep orange-coloured solution, which, on evaporation, yields beautiful crystals, in appearance like those of bichromate of potassa; formula—

$$3(CeOSO_3) + Ce_2O_3 3SO_3 + 18HO.$$

The mother liquor separated from this salt yields a yellow-

coloured salt, of which the following formula exhibits the composition:—

$$CeOSO_3+Ce_2O_3SO_3+8HO.$$

The author, after passing a review of several compounds of cerium, treats, at very great length, of various double salts of the cerium bases, but his essay is too lengthy, on the one hand, and too full of formulæ on the other, to yield scope for further useful abstraction.

Action of Hypochlorous Acid upon a Mixture of Iodine and Anhydrous Acetic Acid.—M. Schützenberger.—The substance which is the result of the action just alluded to is, when pure, a solid crystalline body, which, according to the results of analysis, has the formula $[(C_2H_3O_2)2Cl]$. The author found that this substance, when dissolved in anhydrous acetic acid, acts, at the ordinary temperature, upon metals (copper, for instance), yielding acetic acid and the iodide of the metal; zinc ethyl violently yielding acetate of zinc, acetate of ethyl ether, and iodide of ethyl. The substance does not act upon dry benzol at the ordinary temperature; but if the mixture is heated up to the boiling point of the benzol, the compound of iodine and anhydrous acetic acid dissolves therein, and deposits again from it on cooling.

Quantitative Estimation of Copper by Sulphuretted Hydrogen.—M. E. Ulrici.—The main results of the author's researches may be briefly summarised thus:—1st. When the precipitate occasioned, in solutions of copper, by sulphuretted hydrogen, is submitted to strong ignition in an open or covered porcelain crucible, the residue of this ignition is almost always a compound exactly corresponding, by calculation, to the formula Cu_2S. 2nd. This residue is always a mixture of Cu_2S and CuO. 3rd. The result of ignition in a closed porcelain crucible, the lid of which is only now and then removed, will yield a chocolate brown-coloured compound, agreeing with the formula Cu_2S+CuO. The author states that a series of experiments has convinced him that the precipitate obtained by HS from copper solutions may advantageously be applied, after having been well washed, dried, and ignited, for the quantitative estimation of copper. There is added to this paper a lengthy tabulated form, exhibiting results obtained, which certainly indicate that, with due care, this new method of quantitative estimation may often be advantageously applied.

Tyrosin.—M. Barth.—The author states that the results of a series of researches on this subject led him to the conclusion that tyrosin has to be considered as an oxyphenylamidpropionic acid. The author is engaged with experiments to prove this synthetically.

NOTES AND QUERIES.

Vacuol.—I have met frequently in recent Continental journals with the terms "vacuol" and "vacuolised," in reference to fungi or the cells of fungi. I cannot find these words in Watts's "Dictionary," or in any of the foreign scientific dictionaries. Can any of your readers tell me the meaning of these terms, and with whom they originated?—Carbon.

Wood-Lice.—I should be very much obliged if any of your correspondents can inform me how to destroy wood-lice in beams, floors, and furniture. It should be something that would not injure or discolour the furniture.—Wood Preserver.

Dr. Gladstone's Experiments on Light.—Seeing in your report of Dr. Gladstone's Friday evening lecture at the Royal Institution, delivered April 24, 1868, and contained in your impression of June 5, 1868 (*Am. Repr., Aug.*, '68, *page* 93), that he has discovered that, in the case of liquids, $\frac{\mu-1}{d}$ is constant for all temperatures and for all mixtures, with some slight deviations, owing, apparently, to an undiscovered law, you will confer a great favour on me if you will give me the number.—Aleph.

[Dr. Gladstone informs us that the fact that, in the case of liquids, $\frac{\mu-1}{d}$ is a constant for all temperatures and for mixtures, with some slight deviation, was discovered by Mr. Dale and himself several years ago, and has been verified by some of the German physicists. They (Dr. Gladstone and Mr. Dale) have, however, gone far beyond that now, showing that it is a constant (generally speaking) notwithstanding chemical combination. Dr. Gladstone sent a long paper founded on this to the Royal Society last month.—*Ed.* C. N.]

Drying of Animal and Vegetable Substances.—Dr. Müller.—A large glass vessel, a tumbler for instance, is filled for about half its capacity with fused chloride of calcium, and over this a quantity of ether is poured; on the top of the glass vessel another suitable glass or porcelain vessel is placed containing the substance to be dried, and over these vessels, previously placed on a polished glass plate, a bell-jar is placed. The drying takes place in consequence of the fact that the chloride of calcium withdraws water continuously from the ether, and the vapour of the latter, in its turn, withdraws the water from the substances to be dried. It is stated that both animal and vegetable substances dried by this process retain their natural colour, and that animal substances, moreover, retain their elasticity and flexibility.—*Deutsche Ind. Zeitung.*

Yeast.—The essential cause of the difference of beer-yeast and the so-called German yeast, is due—1st, to the materials submitted to fermentation; 2nd, to the mode of conducting that process. The so-called German yeast is chiefly made at Schiedam, and owes its origin and qualities to the large quantity of raw (that is to say, unmalted) grain, chiefly rye, used for making Hollands. More correctly speaking, the starch of the grain, after having been converted into sugar by the aid of a comparatively small quantity of barley-malt, is suffered to undergo alcoholic fermentation. This fermentation proceeds far more slowly than the fermentation of the wort of malt intended for beer; and it is the slowness of this process, the use of raw grain, and the peculiar mode of setting up the fermentation, which constitute the essential difference of the yeast. After it leaves the distilleries, the yeast is carefully washed with very cold and pure water, and often, though not always, mixed with some very finely-ground starch; and, next, strongly pressed into stout canvas bags, and sent off to Paris, Berlin, Vienna, and elsewhere. If beer-yeast were washed, it would, perhaps, keep a longer time, but never so long as the yeast just alluded to, owing to the fact that the formation of beer-yeast takes place more tumultuously. German yeast has been made perfectly dry over sulphuric acid *in vacuo*, and in that state it may be kept, in well-closed bottles or tin canisters, in a dry and cool place, for any length of time, and has been sent, in good condition, even to Batavia and Calcutta.

Wood Lice.—Oil of turpentine, or, better yet, carbolic acid, especially if care be taken that the latter be pure and colourless, will destroy these insects, without injury to wood-work or furniture, which should be painted over, as it were, with these fluids. If, however, the smell of these substances be objected to, a solution of corrosive sublimate in water, with the addition of some common salt to increase its solubility, may be applied; but this solution is highly poisonous to men and animals.

Estimation of Phosphates in Manures.—A very valuable communication appeared in the Chemical News, vol. xx., p. 77 (*Am. Repr., Oct.*, '69, *page* 212), on the "Estimation of Phosphates in Manures." Will Mr. Sutton, or any of your other correspondents, inform me if it is possible for a superphosphate to go back or lose any portion of its soluble phosphate and at the same time contain an excess of sulphuric acid? which I believe all commercial superphosphates do in a certain degree.—Farmer.

Aniline Colours.—Can any of your correspondents kindly favour me with the best and cheapest method of dissolving aniline colours suitable for calico-printers?—Alexis.

Tungstate of Soda.—Can you tell me if tungstate of soda is a conductor or non-conductor of heat, and where I can get it, and price? I want it to make paper fireproof, or can you tell me of anything else that will make paper fireproof, and at the same time a non-conductor of heat, and cheap?—Alfred Burn.

Printing Scarlet.—Can any of your courteous readers inform me of a substance that will prevent a solution of bichloride of mercury from being decomposed when boiled in a copper kettle, but afterwards permit it to be precipitated as a scarlet biniodide by a solution of iodide of potassium? I wish to print it upon cotton-cloth, using the same *modus operandi* as calico-printing. I find that the copper colour-kettles and printing-rollers decompose it, in consequence of the mercury uniting with the copper. The effect is not satisfactory if I use the solution of iodide of potassium as a mordant. How can I prevent the chloride solution from being decomposed?—Willian.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Books Received.—"Recent Discussions on the Abolition of Patents for Inventions in the United Kingdom, France, Germany, and the Netherlands." London: Longmans, Green and Co. "Chemical Manufacturers' Plant," by Robert Daglish and Co. Lancashire: St. Helen's Foundry. "On Fresh Meat Preservation," by John Gamgee. London: Robert Hardwicke.

AMERICAN SUPPLEMENT.

New York, October, 1869.

The "Ellershausen" Process for Producing Wrought-Iron.

BY H. ENDEMANN, PH.D.

From a book upon the use of gas as fuel in metallurgical and other technical operations, translated from the German, and enlarged by G. T. Coursen, E.M., and the present writer, the following summary of the process, which heads this article, is placed before the readers of this journal.

This process is an American invention, and has excited much interest among the iron-masters of this country. It is based upon the discovery that cast-iron, thoroughly intermingled with oxides of iron, will not melt, and that the products of oxidation by heat can be removed by simple mechanical operations.

The Apparatus.—The machinery, used in mixing the cast-iron and iron ore, consists of a cast-iron turn-table, twelve to fourteen feet in diameter, carrying a trough two feet wide by one foot deep, the outer wall of the trough being attached to the circumference of the table, thus forming a circular trough. The trough is divided into compartments, by vertical cast-iron plates, and the outer wall consists of plates which can be easily detached from the table.

The turn-table revolves upon cog-wheels, being moved by a small engine of five-horse power.

A cast-iron trough connects the tap-hole of the blast-furnace with a stationary receiver, situated upon a line with the circumference of the turn-table and above it.

The receiver has a delivery spout of the same width as the circular trough upon the table. The pulverized iron ore used in making the mixture flows from the bins down an inclined spout to the turn-table, the end of the spout being in close proximity to the end of the delivery spout of the cast-iron receiver, before mentioned.

The Process.—The molten cast-iron flows from the blast-furnace into the receiver, and falls in a thin sheet from the delivery spout into the circular trough, upon the turn-table, meeting, in its descent, the current of iron ore flowing from the opposite direction.

The quantity of ore used varies from 30 to 40 per cent of the cast-iron. The turn-table revolves at a rate of 225 to 250 feet per minute; the trough is thus gradually filled with layers of the mixture; and the outer casing of the trough being removed, the cakes of pig-bloom are detached from the trough. These cakes weigh from 100 to 150 lbs. each, according to the length of the compartments.

The conversion of the cast-iron into wrought-iron, partially effected in the mixing process, is completed by reheating and forging.

Chemistry of the Process.—In the common puddling process, the chemical action of the oxygen of air upon the iron is very slow, as it depends upon exposing the surface of the iron to its action. In the "Ellershausen" process we have the oxygen in a compact form, and are able to mix it at once thoroughly with the iron; so that we reach, with one simple and short heating process, what was accomplished in the old method by a laborious process and great loss. The oxygen of the iron ore combines with the impurities of the cast-iron, and a certain amount of iron being thus freed from the ore, increases the amount of muck-bar produced. The oxidized impurities, as the sulphur and carbon, are partially removed during the mixing process, in the form of sulphurous acid and carbonic oxide; while the remainder, together with the excess of ore, is eliminated by the reheating and forging process.

The oxygen, in the ore used, is more than sufficient to oxidize the impurities of the iron; but experience has proved that the proportion of ore cannot be diminished with safety, by reason of the difficulty of obtaining a thorough mixture. To utilize the surplus of ore, some experiments have been made by mixing a certain quantity of carbon, anthracite, charcoal, or coke dust, with the ore, which reduces part of the iron ore, and increases the product, without interfering with the oxidation of the impurities. These experiments have been attended with some success.

The question, whether the product is as pure as that produced by the old process, is settled by the following analyses made by Otto Wuth, of Pittsburg, Pa., and kindly placed at our disposal by Mr. James P. Speer, of Pittsburg, Pa.

The ores, used for mixing at the works of Messrs. Shoenberger & Co., of Pittsburg, are magnetic ores, of 65 per cent of iron, with no sulphur and traces of phosphorus; and Iron Mountain red hematite of the same percentage.

The ore used by Lyon, Shorb & Co., is brown hematite, containing 53 per cent of iron, 0.21 per cent phosphoric acid, 13 per cent. water, the balance being silica and alumina.

(*a*) Pig metal from Shoenberger & Co.; coke metal smelted from Lake Superior, with a small quantity of Sterling and Marmora ores.

(*b*) Puddled iron from (*a*).

(*c*) Wrought iron from (*a*) by the Ellershausen process:

	(*a*)	(*b*.)	(*c*)
Carbon (chem. comb.)	2·87	0·43	0·39
Graphite	1·34		
Silicon	1·02	0·20	0·09
Sulphur	0·14	0·11	0·006
Phosphorus	0·58	0·12	0·14
Iron	92·46		
Other substances not determined.			

(*i*) Puddled slag from (*b*.)

(*k*) Slag from (*c*).

	(*i*)	(*k*)
Silicic acid	14·02	8·95
Peroxide of iron	17·71	16·01
Protoxide of iron	60·31	68·88
Lime	2·08	1·74
Magnesia	0·84	0·85
Alumina	1·44	1·31
Phosphoric acid	2·54	1·74
Sulphide of iron (?)	0·88	0·72

The sample (*b*) was puddled with old cinder from the puddling furnace, so that some of the resulting slag was due to this fact; while in (*c*) nothing but the iron and ore was used. The larger amounts of phosphoric acid and sulphur in (*i*) than in (*k*) may therefore have been derived from this old cinder rather than from the iron.

A pig-metal smelted at the same works from Marmora ore containing much sulphur, contained—

Sulphur	0.42

The wrought-iron from the same contained, when puddled,

Sulphur..... 0.027

When worked by the Ellershausen process,

Sulphur..... 0.012

(*d*) Pig-metal from Sligo furnace, Lyon, Shorb & Co.
(*e*) Wrought-iron puddled from (*d*).
(*f*) Wrought-iron from (*d*), Ellershausen process:
(*g*) " " " " "
(*h*) " " " " "

	(*d*)	(*e*)	(*f*)	(*g*)	(*h*)
Carbon (combined)	1.05	0.34	0.29	0.31	0.24
Graphite.....	3.86				
Silicon.....	0.93	0.17	0.16	0.07	0.05
Sulphur.....	0.03	trace	trace	trace	trace
Phosphorus.....	0.57	0.25	0.22	0.16	0.15
Iron.....	93.01				
Manganese.....	0.21				
Slag and traces of cobalt and calcium	0.34				

Importance of the Spectroscope in Mineral Water Analyses.

Owing to the recent discovery of the remarkable and valuable Lithia waters at Saratoga and Ballston, which also contain both baryta and strontia, it may be interesting to notice the importance of the spectroscope in enabling the chemist to ascertain with certainty the completeness of the separation and the accuracy of the estimation of these substances in mineral water analyses.

Lithia is generally present in mineral waters as a carbonate, and may be often separated, together with the chlorides, bromides, and iodides of the alkalies, by repeated treatment of the residue obtained by evaporation of such a water to dryness, with boiling water.

If the amount of lithia present is not too great, its separation by boiling water from all the bases, save the alkalies, is readily accomplished; but, if the amount be as great as in some of the Ballston and Saratoga waters, the separation is by no means easy. The only positive proof of the completeness of the separation, in such cases, is obtained by the aid of the spectroscope, it being impossible to detect small quantities of lithia, especially when associated with so much soda and lime, by any ordinary qualitative tests. By the use of the spectroscope, the analyst is enabled to ascertain the accuracy of the separation with ease and certainty. From time to time minute assays of the residue are examined by the spectroscope, and the lithia line is observed to grow fainter and fainter, until, at last, it is no longer discernible.

The water solution, thus obtained, is evaporated to dryness, and the saline residue, after being moistened with hydrochloric acid, and again carefully evaporated to dryness, repeatedly digested with absolute alcohol, until it ceases to give a lithia reaction with the spectroscope.

The alcoholic solution obtained by this treatment is evaporated to remove the alcohol, the residue dissolved in water, and the lithia separated in the usual manner with phosphate of soda, the purity of the phosphate of lithia obtained being tested by the spectroscope.

In mineral waters, containing a large amount of lithia, it is sometimes impossible to entirely separate it from the residues obtained by evaporation, even by a very prolonged treatment with boiling water. After the constant treatment of such a residue for several days with boiling water, it still gave a characteristic spectroscopic reaction for lithia. In such cases the residue is dissolved in hydrochloric acid; the solution evaporated to dryness in order to remove silicic acid; iron and alumina removed, from the filtrate from the silicic acid, by ammonia; lime, baryta and strontia by carbonate of ammonia, and magnesia by hydrate of lime. In the separation of lithia by this process, the spectroscope is of great importance, inasmuch as the various precipitates are readily and surely tested by its use, and the washing of them all is to be continued until the lithia reaction ceases to appear.

In the analysis of mineral waters containing baryta and strontia, the certainty of accuracy in the separation of these bases from lime and from each other is much increased if the analysis be controlled by the use of the spectroscope. In case the mixed sulphates of lime, baryta, and strontia have been obtained in the course of analysis, and the strontia and lime are to be removed by digestion with carbonate of ammonia, the purity of the remaining sulphate of baryta can only be readily ascertained by means of the spectroscope. So, too, in the separation of strontia from lime by treatment of the nitrates with a mixture of alcohol and ether, the insoluble nitrate of strontia may retain lime, which, if not detected by the spectroscope, would probably figure in the analyst's report as strontia.

Edward W. Root.

The American Association for the Advancement of Science.

After a session of seven days, duration, the Association adjourned, August 25th, to meet in Troy, August 7, 1870. The Society had its origin, in 1840, in Philadelphia, under the title of "The Association of American Geologists." At the meeting held in Boston, in 1842, the scope of the Society was widened, and the title of "The Association of American Geologists and Naturalists was adopted." In 1847 the present name was assumed by the Association.

Great interest was manifested in the meeting this year, 250 members attending, and 160 papers being presented. Two new subsections were organized, one embracing Ethnography and Anthropology, and the other Microscopy.

The officers elected for the meeting of 1870 are as follows:

President, Prof. William Chauvenet, of St. Louis.

Vice-President, Prof. T. Sterry Hunt, of Montreal.

Permanent Secretary, Prof. Joseph Lovering, of Cambridge.

General Secretary, Prof. Charles F. Hartt, of Ithaca, N. Y.

Treasurer, Dr. A. L. Elwyn, Philadelphia.

Standing Committee.—Samuel Felton, Philadelphia; M. D. Hanover, Cincinnati; L. H. Morgan, Rochester, N. Y.; Col. J. W. Foster, Chicago; J. D. Warner, Brooklyn, N. Y.; W. B. Ogden, N. Y.; J. H. Devereux, Cleveland; Dr. G. B. Lewis, Salem, Mass.

But few of the papers presented this year related strictly to chemistry. Some of the physical papers were of special interest to chemists.

Prof. Van der Weyde read a paper on the determination of the mechanical equivalent of heat by means of the modern ice and cooling machines; he referred to the great loss of power in transforming heat into motion, while in the reverse process the full equivalent is

obtained, namely, 770 foot-pounds for every unit of heat. He showed that in producing cold (negative heat) the full equivalent was obtained, as the result of actual experiment. Prof. Van der Weyde made the interesting statement, that with one of the ordinary machines one ton of coal produces cold equal to the consumption of fourteen tons of ice.

Prof H. Wurtz read a paper on the Grahamite of West Virginia; he considers it inspissated petroleum, and not to be classed with coal, Albertite, or asphaltum. It is almost wholly dissolved by bisulphide of carbon and by chloroform, forming a dark brown liquid. This contains two substances, *viscosine* and *iriscine*, which are separated by means of sulphuric acid. *Viscosine* is a viscous hydrocarbon, insoluble in most menstrua. When a solution of *iriscine* is allowed to evaporate in a thin layer, a beautiful iridescence is developed, which appears to be a characteristic reaction, and suggested the name of *iriscine*. Grahamite has been recently discovered in Colorado, resembling the Virginia mineral in every respect.

Mr. W. R. Nichols presented a paper giving the results of analyses of the oxalates of the alkalies. He confirmed Rammelsberg's formula for the binoxalate of potassium $4(C_2KHO_4)+aq.$, and found that of the ammonia salt to be $2(C_2(NH_4)HO_4)+aq.$, and not $C_2(NH_4)HO_4+aq.$, as generally given. Mr. Nichols also gave a table of the solubility of various oxalates, the estimations being made by titrition, with permanganate of potash.

Prof. Seely gave his views with regard to the classification of the elements, which have been fully set forth in previous numbers of the Chemical News. He also presented his new method for the estimation of carbonic acid.

Prof. Gustavus Hinrichs also read an article on the Classification of the Elements, based on the mobility of the particles of the different elements, as expressed in their volatility and fusibility. He made use of a series of charts, of which it is difficult, within the limits of this abstract, to convey an understanding. Prof. Hinrichs further called attention to the variations between Stas' figures and whole numbers in his determinations of the atomic weights. He showed that in certain groups the fractions were all plus, and in others minus, and they increase with the atomic weight of the element, thus:

Li	7	+ 0·022
Na	23	+ 0·043
K	39	+ 0·137
Cl	35·5	− 0·025
Br	80	− 0·048
I.	127	− 0·150

These variations he calls perturbations, the cause of which remains to be explained; he considers Stas' determinations the very best support of Prout's theory.

Prof. Horsford announced the discovery of phosphoric acid, iron, and potassium as constituents of chlorophyll. He also gave some newly discovered properties of phosphoric acid.

T. Sterry Hunt read some notes upon the chemistry of copper, and Profs. Silliman and Wurtz presented a paper upon flame temperatures in their relations to compositions and luminosity. Prof. Silliman also read a paper on the relation between the intensity of light produced by the combustion of illuminating gas and the volume of the gas consumed. He approved Farmer's theorem, that the intensity of gas flames (*i. e.*, their illuminating power) increases, within ordinary limits of consumption, as the square of the volume of gas consumed. In variations from the standard of consumption of five cubic feet of gas, and one hundred and twenty grains of sperm candle, the observed data are computed up or down by the rule of three. Governed by this rule, a gas, burning three and a half feet per hour, gave 28·57 candles as its value. But calculated by Farmer's rule, 40 candle power was the result. Prof. Silliman gave results of experiments made by him to prove Farmer's rule to be correct.

The National Academy of Science.

The annual meeting of this body occurred at Northampton, Mass., September 1st and 2d, and adjourned to meet on the 3d Tuesday of April, 1870, in Washington. The papers presented were highly interesting. We have space merely for the titles.

Arrangement of Volcanoes on the Earth, and their Influence on our Globe. By Prof. Guyot.

On the Rocky Mountains. By Prof. Hall. On the Rotation of the Earth. By General Barnard. Dr. Wolcott Gibbs read a short paper upon a special formula in chemistry; Dr. Gould and Dr. L. Alexander, interesting papers upon the eclipse; Captain John Ericsson presented a paper on the Retardation of the Earth's Rotation by Solar Influence; Prof. Henry, On Subjective Colors and their Application to Solar Eclipses; Prof. Silliman read a paper by Prof. A. C. Twining, on the recent eclipse; Prof. Barker one on salt, by Prof. C. A. Goessmann; and Prof. Gibbs one on the Aurora Borealis, by W. H. Dall.

American Pharmaceutical Association.

The seventeenth annual session of this Association commenced September 7th, in Chicago.

In connection with the meeting, an exhibition of chemicals and apparatus was held in an adjoining hall. All the principal manufacturers were represented. A microscopical exhibition at the Academy of Sciences also added to the interest of the occasion. The papers presented were of a highly interesting character. A series of resolutions was passed, recommending the passage of a law, by the legislatures of the several States, regulating the practice of pharmacy, and requiring a proper degree of qualification and education in persons engaging in the practice of pharmacy.

The next meeting will be held in Baltimore the second Tuesday in September, 1870.

Dangerous Kerosene.

According to the Fire Marshal's report, there were sixty-four fires in New York during the month of August, and of this number seven were caused by *kerosene*. Deaths by explosions are frequent. Out of over a hundred samples of oil tested in the laboratory of the Board of Health, only one attained the requirements of the law. In several instances naphtha was sold as a "*safety oil*."

Not only do the manufacturers sell oil below the standard, but the retailers adulterate this with naphtha.

The legislature should enact a law making this a crime as great as that of arson. In the meantime, the Board of Health should continue to test the oils sold, and to publish the names of the dealers, and bring them to justice. By such agitation the public will be brought to a proper understanding of the danger.

Recent Chemical Patents.

Issued August 24, 1869.

93,952.—Apparatus for Removing Benzine from Hydrocarbons. H. J. Berg, Butler, Pa.

93,972.—Cooling Soap, and Forming the same into Bars. S. R. Divine, New York.

93,988.—Manufacture of Rosin and Spirits of Turpentine. J. F. Griffen, New York.

94,008.—Apparatus for Clarifying Cane-Juice by Means of Sulphurous Acid Gas. A. Labauve, Convent, La.

94,073.—Manufacture of Soap. W. T. Bush, Obion county, Tenn.

94,079.—Composition for Gumming Postage and Revenue Stamps. C. L. Coombs, Washington, D. C.

94,080.—Composition of Matter for Various Uses in the Arts. C. L. Coombs, Washington, D. C.

94,084.—Composition for Covering Steam Boilers, Pipes, and other Articles. W. B. Davis, Brooklyn, N. Y.

94,131.—Manufacture of Paper. J. B. Read, Tuscaloosa, Ala.

94,157.—Generating Gas for Motive Power, for Extinguishing Fires, and for other purposes. C. G. Wheeler, Chicago, Ill.

Issued August 31, 1869.

94 204.—Method of Seasoning and Preserving Wood. T. W. Heinemann, New York.

94,214.—Manufacture of Carbonate of Lead, Acetate of Copper, and Acetate of Iron. O. Jacobi, Philadelphia, Pa.

94,220.—Printers' Ink. C. Kregei, Scranton, Pa.

94,228.—Process of Preparing Wood-Fibre for Paper Stock. G. E. Marshall, Laurel, Ind.

94,246.—Process for Extracting Oils, &c. C. A. Seeley, New York.

94,297.—Manufacture of Illuminating Gas. C. F. Dunderdale, New York.

94,298.—Apparatus for Purifying Saccharine Liquids, and Curing, Drying, and Treating Sugar and other Materials. W. B. Espent, Spanish Town, Jamacia.

94,306.—Furnace for Producing Iron Direct from the Ore. W. Griffith, Jr., Pottsville, Pa.

94,343.—Evaporation for Sugar and other Liquids. T. Scantlin and J. M Scantlin, Evansville, Ind.

94,359.—Mode of Bleaching Granulated Sugar. T. C. Taylor, Philadelphia, Pa.

94,360.—Apparatus for Carburetting Air and Gas. O. Tirrill, Boston, Mass.

94,374.—Roasting and Treating Iron Ores. H. Atkin, Falkirk, Scotland.

94,411.—Mode of Obtaining Fibre and other Products from the Maize Plant. J. T. Harris, Tyngsborough, Mass.

94,450.—Mode of Cooling and Freezing Liquids and other Substances. A. H. Tait, New York.

94,460.—Mode of Cleaning Musty Beer and other Casks. D. Willard, Jr., Pittsford, N. Y.

Issued September 7, 1869.

94,471.—Manufacture of Pig Iron. J. Burt, Detroit, Mich.

94,479.—Process of Preparing Grain for Mashing. F. W. De Spessbourg, Normandy, France.

94,508.—Apparatus for Assaying and Testing Ores and Metals. J. S. Phillips, San Francisco, Cal.

94,509.—Process of Concentrating and Granulating Saccharine Liquids. J. P. Wigan, England.

94,532.—Metallic Alloy for Filtering Oils, and for the Manufacture of Paints, Cements, &c. J. Webster, Birmingham, England.

94,581.—Compound to be used as a Mordant in Dyeing and Printing. F. S. Dumont, New York.

94,584.—Still. C. K. Dutton, Newbern, N. C.

94,596.—Manufacture of Illuminating Gas. G. W. Harris, Elizabeth, N. J., and H. Holdrege, New York.

94,605.—Composition Flux, for Manufacture of Iron and Steel. J. Jameson, Philadelphia, Pa.

94,611.—Apparatus for Distilling and Rectifying Spirits. G. Kaiser, New York.

94,626.—Preserving Wood from Decay and Mildew. A. R. McNair, New York.

Issued September 14, 1869.

94,736.—Artificial Marble or Plastic Material. H. A. Garvey, Memphis, Tenn.

94,797.—Sizing for Paper Manufacturers and others. Z. C. Warren and H. C. Hulbert, Brooklyn, N. Y

94,799.—Process of Rectifying and Refining Whiskey and other Spirits. H. Webster, New York.

94,805.—Composition of Liquids for Tanning. J. Wood, Woodstock, Vt.

94,832.—Compound of Hard Rubber and Fibrous Material. R. O. Lowrey, Salem, N. Y.

94,869.—Solution for the Treatment of Wood. E. W. Clark, Hartford, Conn.

94,880.—Manufacture of Beer, Ale, and other Fermented Liquors. J. Firmenich, Buffalo, N. Y.

94,898.—Apparatus for Carburetting Air. J. Lafrogne, Paris, France.

Reissues and Extensions.

63,300, reissue 3,620.—Process of Preserving Wood and Timber. D. R. Prindle, East Bethany, N. Y.

13,416.—Improvement in Making White Zinc. J. E. Burrows, Newark, N. J.

10,722, reissue 3,629.—Fibre from Cane for Paper and for other purposes. K. Lowe and W. McTeer, Baltimore, Md.

56,044, reissue 3,640.—Composition for rendering Paints Fire-Proof. J. O. Swinney, Glasgow, Mo., and A. H. Pollock, Germantown, Ky.

BREVITIES.

Chancellor William Chauvenet, of Washington University, of St. Louis, has resigned on account of ill health.

Charles A. Shaffer, formerly assistant in the chemical laboratory at Union College, and who has lately returned to this country from Europe, where he pursued his studies at Göttingen University, has been appointed Professor of Analytical Chemistry in Cornell University.

Prof. Cyrus Northrop has declined the presidency of the Alabama State University.

Prof. Brewer, of the Sheffield Scientific School, and Prof. Whitney, of the Lawrence Scientific School, have travelled during the past summer in the Western Country. They visited the headwaters of the Arkansas River, naming two of the peaks Yale and Harvard.

Thomas Graham, M.A., D.C.L., F.R.S., died in London, September 18th, in the sixty-fourth year of his age. His name and reputation are familiar to every chemist. He has held the position of Professor of Chemistry in the University of Glasgow and in the University of London, and at the time of his death ably filled the position of Master of the Mint. His *Elements of Inorganic Chemistry* has been a leading text-book for many years.

Peter Mark Roget, M.D., F.R.S., died in London, September 17th, in the ninety-first year of his age. His writings include a work on "Animal and Vegetable Physiology," the "Thesaurus of English Words and Phrases," and very numerous papers in the scientific journals and encyclopædias of England. He was Professor of Physiology in the Royal Institute, and a member of the leading scientific societies.

AMERICAN DRUGGISTS' PRICE-CURRENT—NEW YORK.—JOBBERS' PRICES.

DRUGS AND CHEMICALS.

Aceton	per oz		to		35
Acid, Acetic, No. 8	per lb		to		18
sp. gr. 1,047 U.S.P.	per lb		to		28
Chemically Pure	per lb		to		55
Glacial	per lb		to	1	60
Benzoic, German	per oz		to		30
Boracic, pure	per lb		to		85
Citric	per lb		to	1	10
Fluoric, 1 lb bottles	per lb		to	2	30
Formic	per lb		to	3	00
Gallic	per lb		to	3	00
Hydrophosphorous	per lb		to	4	25
Lactic	per lb		to	4	25
Muriatic, 18 degrees	per lb		to		5
chemical pure	per lb		to		35
Nitric, 38 degrees	per lb		to		15
chemical pure	per lb		to		38
Oxalic, patent	per lb		to		33
Phosphoric, glacial	per lb		to	3	00
Prussic	per oz	8	to		9
Sulphuric	per lb	4	to		5
chemical pure	per lb		to		50
Valerian	per oz		to	1	40
Tartaric, powdered	per lb		to		80
Aconite Leaves	per lb		to		28
Aconitia	per dr		to	5	00
Agaric Alba	per lb		to		80
Alcohol, 95 per ct	per gal		to	2	60
Aloes, Cape, powdered	per lb		to		36
Socotrine, powdered	per lb		to	1	00
Alum, Roman	per lb		to		11
lump	per lb		to		4½
Ambergris, gray	per oz		to	14	00
Ammonia Carbonate, bulk	per lb		to		25
in jars	per lb		to		26
Muriate	per lb		to		16½
Ammonia Aqua, 20 degrees	per lb		to		12
26 degrees	per lb		to		22
Hypophosphite	per lb		to	4	00
Oxalate	per lb		to	2	00
Phosphate	per lb		to	2	00
Sulphate	per lb		to		10
Ammonium Valerian. Crystals	per oz		to	1	30
Ammonium Bromide	per lb		to	2	50
Hydrosulphuret	per lb		to		75
Iodide	per lb		to	8	50
Amygdalin	per oz		to	3	75
Antimony and Potass	per lb		to	1	10
Butter	per lb		to		30
Arnica Leaves	per lb		to		20
Arrow Root, Bermuda	per lb		to		45
St. Vincent	per lb		to		18
Arsenic, white powdered	per lb	8	to		10
red pulv	per lb		to		30
red, lump	per lb		to		20
Arsenic Solution, Fowler's	per lb		to		16
Iodide	per oz		to		90
Sol., Donovan's	per lb		to		30
Asbestos	per lb		to		15
Asparagin	per oz		to		
Atropia	per dr		to	3	25
Sulphate	per dr		to	3	25
Valerian	per dr		to	4	50
Balsam Fir	per gal		to	3	50
Copaiva	per lb		to		95
Peruvian	per lb		to	6	00
Tolu, true	per lb		to	1	30
Barbadoes Tar	per lb		to		12½
Bark, Elm	per lb		to		18
Bark, Calisaya, quill	per lb		to	1	65
Red, quill	per lb		to	1	85
Pitayo	per lb		to		80
Cascarilla	per lb		to		25
Mezereon	per lb		to		28
Sassafras	per lb		to		10
Baryta Muriate	per lb		to		30
Nitrate	per lb		to		40
Bay Rum	per gal		to	3	00
Bebeerin, pure	per oz		to	5	50
Sulphate	per oz		to	3	50
Belladonna Leaves	per lb		to		25
Bicarbonate Soda	per lb		to		7
Bichromate Potash	per lb		to		23
Bismuth Metallic	per lb		to	8	50
and Ammonia Citrate soluble	per oz		to		90
and Ammonia Citrate Solution	per lb		to	1	30
Oxychloride	per lb		to	7	25
Subcarbon	per lb		to	8	25
Sub-Nitrate	per lb		to	7	00
Tannate	per oz		to	1	50
Valerianate	per oz		to	2	40
Black Drops	per lb		to	4	75
Blue Mass	per lb		to		56
Bole, Armenia, true	per lb		to		10
Borax, refined	per lb		to		40
Brimstone, roll	per lb		to		5
Bromine	per lb		to	3	00
Brucia	per oz		to	3	75
Buchu Leaves, long	per lb		to		60
short	per lb		to		33
Burgundy Pitch, true	per lb		to		15
Cadmium, Bromide	per oz		to		50
Iodide	per oz		to		65
Metallic	per lb		to	4	40
Sulphate	per lb		to	7	50
Caffeine	per oz		to	9	00
Calcium Chloride	per lb		to		90
Iodide	per lb		to	8	50
Calisaya Bark, Milhau's Original Elixir of	per doz		to	11	00
" " "	per gross		to	120	00
Calisaya Bark, Milhau's Chalybeate Elix. of	per doz		to	11	00
" " "	per gross		to	120	00
Calomel, Hydrosub	per lb		to	1	00
Camphor, Refined	per lb		to		95
Cannella Alba	per lb		to		28
Cantharides, powdered	per lb		to	2	20
Carbolic Acid crystals	per oz		to		17
" " solution	per lb	60	to		85
" " " common	per lb		to		35
Carbon Bi-Sulphuret	per lb		to		42
Cascarilla Bark	per lb		to		20
Cassia Buds	per lb		to	1	15
Castor Oil	per gal		to	2	90
Caustic Soda	per lb		to		9
Centaury Minor	per lb		to		20
Cerium, Oxalate	per oz		to	1	15
Nitrate	per oz		to	1	60
Chalk, Precip., English	per lb		to		23
Cherry Laurel Water	per lb		to		58
Chlorate Potass, English	per lb		to		48
Chloride Lime	per lb		to		8
Chloroform	per lb		to	1	35
Cinnamon, Ceylon, true	per lb		to	1	75
Citrine Ointment	per lb		to		58
Civet	per oz		to	5	50
Cobalt	per lb		to		26
Cocculus Indicus	per lb		to		38
Cocoa Butter	per lb		to	1	00
Codeine	per dr		to	2	50
Cod Liver Oil	per gal		to	2	25
Cod Liver Oil, "Shore Oil")	per gal		to	2	15
Cod Liver Oil, J. C. Baker & Co.'s	per doz		to	8	00
" " "	per gross		to	90	00
" " " ...5 gross,	per gr		to	87	00
Cod Liver Oil, Hazard & Caswell's	per doz		to	7	50
" " "	per gr		to	90	00
Cod Liver Oil, Milhau's Golden	per doz		to	7	00
" Milhau's Etherized	per gross		to	78	00
Cod Liver Oil, Milhau's, with the Hypophosphite of Lime	per doz / per gross		to	7 / 84	50 / 00
Collodion	per lb		to	1	65
Cantharidal	per doz		to	4	50
Colocynth, powdered	per lb		to		75
Confectio Rosæ	per lb		to		48
Sennæ	per lb		to		48
Conium Leaves	per lb		to		25
Coniin	per oz		to	7	50
Copper Ammoniated	per lb		to	1	20
Black Oxide	per lb		to	2	20
Carbonate	per lb		to	2	20
Sulphate, pure	per lb		to		38
Copperas	per lb		to		4
Corrosive Sublimate	per lb		to		95
Cream Tartar, powdered, pure	per lb		to		47½
Cubebs	per lb		to		33½
Cubebin	per dr		to		25
Cuttlefish Bone	per lb		to		28
Digitalis Herb	per lb		to		18
Digitaline	per dr		to	3	65
Dover's Powder	per lb		to	2	75
Dragon's Blood, mass	per lb		to	1	00
reeds	per lb		to	1	10
Dulcamara Stems	per lb		to		18
Emetine	per oz		to	3	65
Emery Corn	per lb		to		11
Flour	per lb		to		8
Epsom Salts	per lb		to		4½
Ergot, new	per lb		to	1	30
Ergotine	per oz		to	1	15
Ether, Acetic	per lb		to		82½
Butyric, concentrated	per lb		to	4	00
Butyraceous	per lb		to	1	75
Chloric	per lb		to		87½
concentrated	per lb		to	1	50
Formic	per lb		to	4	00
Sulphuric	per lb		to		70
washed	per lb		to		80
concentrated	per lb		to		90
Extr. Jockey Club, Chiris	per lb		to	3	65
Extr. Ess. Bouquet, Chiris	per lb		to	3	75
Extr Banana, superior	per lb		to	1	25
Extr. Orange, superior	per lb		to	1	25
Fluor Spar	per lb		to		16
Flowers, Althea	per lb		to		42
Arnica	per lb		to		22
Borrago	per lb		to		95
Chamomile, German	per lb		to		40
Chamomile, Roman, 1867	per lb	36	to		88
Lavender	per lb		to		9
Malva, large	per lb		to		40
small	per lb		to		45

Flowers, Rosemary	per lb		to	70
Tiliae	per lb		to	70
Violet	per lb		to	68
Fusel Oil, purified	per lb		to	2 00
Ferro - Phosphorated Elixir of Calisaya	per doz		to	12 00
Bark, Hazard & Caswell's,	per grs		to	144 00
Gamboge	per lb		to	1 10
Gelatine French Pink	per lb		to	1 45
Gelatine, White French	per lb	85	to	1 00
Cox's	per doz		to	2 50
Ginger, Jamaica, bleached	per lb		to	29
Ginseng	per lb		to	85
Glauber Salts	per lb	3	to	4
Glycerine, common	per lb		to	35
concentrated	per lb		to	50
"Bowers"	per lb		to	80
"Price's"	per lb		to	1 00
Glycerole Hypophosphite	per lb		to	1 75
Grains D'Ambrette	per lb		to	60
Paradise	per lb		to	30
Gum Acroides	per lb		to	24
Amber	per lb		to	50
Ammoniac	per lb		to	60
Arabic, Turkey, sorts	per lb		to	55
1st picked, Trieste	per lb		to	95
2d " "	per lb		to	75
3d " "	per lb	55	to	60
Barbary	per lb		to	40
Assafœtida	per lb		to	50
Benzoin, common	per lb		to	70
prime	per lb		to	90
white marbled	per lb		to	1 00
Copal, Accra	per lb		to	
Benguela	per lb		to	30
Kowrie	per lb		to	45
Damar, Batavia	per lb		to	60
Singapore	per lb		to	55
Elemi, Aromatic	per lb		to	55
Euphorbium	per lb		to	25
Galbanum	per lb		to	1 00
strained	per lb		to	1 25
Gedda	per lb		to	28
Guaiacum	per lb		to	50
strained	per lb		to	55
Kino	per lb		to	50
Mastic	per lb		to	4 25
Myrrh, Turkey, powdered	per lb		to	70
Olibanum	per lb		to	30
tears	per lb		to	40
Sandarac	per lb		to	65
Shellac, Campbell's D. C	per lb		to	55
Garnet	per lb		to	50
No. 2	per lb		to	45
Native	per lb		to	45
Senegal	per lb		to	50
Tragacanth, common	per lb		to	50
flake	per lb	1 30	to	1 50
flaky sorts	per lb		to	60
Harlem Oil, Dutch	per doz		to	50
Hoffman's Anodyne	per lb		to	48
Hydriodate Potash, Atkinson's	per lb		to	5 25
Conrad's	per lb		to	5 10
Hyoscyami Leaves	per lb		to	26
Hypophosphite Ammon	per lb		to	3 60
Iron	per lb		to	8 25
Lime	per lb		to	3 50
Manganese	per lb		to	14 00
Potash	per lb		to	3 50
Soda	per lb		to	3 50
Iceland Moss	per lb		to	10
Indian Hemp, true	per lb		to	1 00
Insect Powder, true	per lb		to	1 10
Iodine, Resublimed	per lb		to	6 75
Crude, in bulk	per lb		to	6 50
Irish Moss	per lb		to	10
Iron, Alum	per lb		to	1 60
by Hydrogen	per lb		to	2 50
Carb. Proto	per lb		to	45
Precip	per lb		to	25
Citrate and Ammonia	per lb		to	1 45
Magnesia	per lb		to	1 35
Quiniæ	per lb		to	10 00
Strychnine	per lb	10 00	to	12 50
Hypophosphite	per lb	8 40	to	8 50
Iodide	per lb		to	8 25
Syrup	per lb		to	80
Lactate	per lb		to	3 25
Phosphate, Precipitate	per lb		to	67
Pyrophosphate	per lb		to	1 35
Syrup	per lb		to	65
Sesquichloride	per lb		to	1 45
Sol	per lb		to	60
Sesquinitrate	per lb		to	44
Subsulphate	per lb		to	1 70
Sulphate, pure	per lb		to	9
Exsiccat	per lb		to	17
Sulphuret	per lb		to	31½
Superphosphate Syrup	per lb		to	65
Tannate	per lb		to	6 60
India Ink	per lb		to	1 75
Isinglass, American	per lb		to	1 15
Russian, true	per lb		to	6 50
Juniper Berries	per lb		to	6
Juniper Tar Soap, Hazard & Caswell's	per doz		to	3 75
Kreosote, white	per lb		to	1 15
Lactucarium	per oz		to	75
Lead Acetate, pure	per lb		to	90
Licorice Paste, solid	per lb		to	40
Sicily	per lb		to	30
Calabria	per lb	44	to	45
Imitation	per lb		to	37
Barracco	per lb		to	44
P. S	per lb		to	45
Lime, Carbonate, Precipitate	per lb		to	22
Hypophosphite	per lb		to	3 75
Iodide	per lb		to	8 50
Phosphate, Precipitate	per lb		to	40
Sulphite	per lb		to	31
Lime Juice	per gal		to	1 50
Lint, Taylor's	per lb		to	1 80
Lapis Calaminaris	per lb		to	8
Laurel Berries	per lb		to	12
Leaves	per lb		to	12
Liquid Styrax	per lb		to	60
Long Pepper	per lb		to	90
Lunar Caustic, pure	per oz		to	1 30
67 per cent., N. S	per oz		to	90
Lycopodium	per lb		to	60
Magnesia Carbonate	per lb		to	42
Calcined	per lb	95	to	1 20
ponderous	per lb		to	1 80
Citrate	per lb		to	1 75
Sulphite	per lb		to	1 20
Manganese, powdered	per lb		to	8
Saxony	per lb		to	12
Manna, small flake, '68	per lb		to	1 75
large flake, '67	per lb		to	2 25
sorts, new	per lb		to	1 30
Matico Leaves, true	per lb		to	50
Mercury	per lb		to	90
cum Creta	per lb		to	53
Magnesia	per lb		to	1 22
Cyanuret	per lb		to	5 80
Sulphuret	per lb		to	80
Mercurial Ointment (⅓M)	per lb		to	70
(⅓M)	per lb		to	53
Morphia Sulphate	per oz		to	9 00
Acetate	per oz		to	9 00
Muriate	per oz		to	9 00
Valerianate	per oz		to	11 00
Musk, true	per oz		to	16 00
in grain true	per oz		to	32 00
Nux Vomica	per lb		to	14
Oil, Amber, Crude	per lb		to	60
Almonds (Expressed) Allen's	per lb		to	75
Essential, Allen's	per lb		to	24 00
Anise	per lb		to	4 25
Bergamot	per lb	6 00	to	7 00
FF, new crop	per lb		to	6 00
Bergamot, Donner's	per lb		to	7 00
Bergamot,—Sanderson's	per lb		to	7 50
Cade	per lb		to	1 00
Cajeput	per lb		to	2 00
Camphor	per lb		to	1 75
Caraway	per lb		to	2 75
Seed	per lb		to	5 50
Cassia	per lb		to	3 75
Cinnamon, true	per oz		to	1 25
Citronella, prime	per lb		to	2 37½
Winter's	per lb		to	2 75
Copaiva	per lb		to	3 00
Croton	per lb		to	3 50
Cubebs	per lb		to	4 00
Cummin	per lb		to	10 00
Fennel	per lb		to	3 00
Geranium	per lb	12 00	to	22 00
Chiris	per lb		to	14 00
Prepared	per lb		to	25 00
Turkish	per lb	14 00	to	18 00
Jessamine	per lb		to	3 50
Juniper	per lb		to	1 20
Berries, true	per lb		to	3 50
Lavender, Garden, forte	per lb		to	1 65
fine	per lb		to	1 85
Flowers, Chiris, No. 1	per lb		to	3 75
Lavender Spike	per lb		to	1 00
Laurel, Expressed	per lb		to	90
Lemon, Donner's	per lb		to	4 50
Lemon,—G. R. & Co's	per lb		to	4 30
—Sanderson's (new)	per lb		to	4 50
Lemongrass,—Winter's	per lb		to	4 50
Mace, Expressed	per lb		to	2 50
Marjoram	per lb		to	1 75
Myrrbane	per lb		to	2 00
Neroli Bigarade	per oz		to	4 75
Chiris	per oz		to	4 75
Petit Grain	per lb		to	23 00
Olive, pure	per gal		to	1 75
Marseilles, quarts	per box		to	5 50
pints	per box		to	6 50
Orange	per lb		to	3 50
Origanum	per lb	75	to	1 40
Patchouly	per oz		to	4 25
Pennyroyal	per lb		to	3 75
Peppermint, pure	per lb		to	4 25
Rhodium	per lb		to	10 00
Rose, Kissaulick	per oz		to	10 00
Rosemary, French	per lb		to	1 75
Trieste	per lb		to	1 15
Chiris	per lb		to	2 25

Oil, Sabine, pure	per lb	to	1 70
Sassafras	per lb	to	1 05
Sesame, Salad, fine	per gallon	to	2 60
Spearmint, Hotchkiss	per lb	to	5 00
Spike	per lb	to	
Succinum, crude	per lb	to	60
rectified	per lb	70 to	1 25
Tanzy,—"Eastman's"	per lb	to	5 00
Thyme, white, pure	per lb	to	2 75
Valerian	per lb	to	18 00
Wintergreen	per lb	to	4 75
Wintergreen, Van Deusen Bros.	per lb	to	4 75
Wormwood	per lb	to	7 00
Wormseed, Western	per lb	to	2 75
Baltimore	per lb	to	3 50
Black Pepper	per lb	to	1 25
Cognac	per oz	to	3 50
Ergot	per oz	to	25
Opium	per lb	to	12 00
Orange Buds or Apples	per lb	to	18
Curacoa Ribs	per lb	to	28
Otto Rose, pure	per oz	to	10 00
commercial	per oz	to	7 00
Peppers, Zanzibar	per lb	to	35
Phosphorus	per lb	to	1 20
Amorphous	per lb	to	3 25
Piperin	per oz	to	1 50
Podophyllin	per oz	to	75
Poppy Heads	per lb	to	25
Potassa, Acetate	per lb	to	75
Bicarbonate	per lb	to	35
Carbonate	per lb	to	20
Caustic, common	per lb	to	65
white	per lb	to	90
Citrate	per lb	to	1 15
cum Calce	per lb	to	75
Hypophosphite	per lb	to	4 25
Permanganate, ordinary	per lb	to	80
Phosphate	per lb	to	2 75
Prussiate	per lb	to	44
Sulphate	per lb	to	16
Tartrate	per lb	to	1 05
Potassium	per oz	to	3 75
Bromide	per lb	to	1 60
Cyanide, fus	per lb	to	75
gran	per lb	to	1 40
Iodide	per lb	to	5 10
Sulphuret	per lb	to	35
Quinine, Citrate, with Iron	per oz	to	85
Sulphate, American	per oz	to	2 50
French	per oz	to	2 40
Quassia, rasped	per lb	to	7
Red Chalk Fingers	per lb	6½ to	7
Red Precipitate	per lb	to	1 15
Resin of Jalap, pure	per lb	to	28 00
Rochelle Salt	per lb	to	53
Roots, Aconite	per lb	to	24
Alkanet	per lb	17 to	18
Althea	per lb	to	22
Angelica	per lb	to	35
Calamus	per lb	20 to	60
Colchicum	per lb	to	20
Colombo	per lb	to	20
Culveris	per lb	to	20
Dandelion	per lb	to	30
Galangal	per lb	to	12
Gentian	per lb	17 to	18
Ginger, Race, African	per lb	to	20
Jamaica, Bleached	per lb	to	29
Golden Seal	per lb	to	30
Hellebore black	per lb	to	16
white, powdered	per lb	to	30
Ipecacuanhæ	per lb	to	2 75
powdered	per lb	to	3 00
Jalap	per lb	to	1 80
powdered	per lb	to	2 00
Licorice	per lb	to	18
Mandrake	per lb	to	15
Orris, Florentine	per lb	to	17
Verona	per lb	to	15
Pink	per lb	to	33
Rhatany	per lb	to	30
Rhubarb, E. I.	per lb	2 50 to	4 00
Turkey	per lb	to	24 00
Sarsaparilla, Honduras	per lb	to	56
Mexican	per lb	to	22
Turbeth	per lb	to	60
Valerian, English	per lb	to	50
Dutch	per lb	to	35
German	per lb	26 to	35
Vermont	per lb	to	38
Snake, Virginia	per lb	to	44
Seneca	per lb	to	45
Rose Leaves	per lb	to	2 50
Rosemary Leaves	per lb	to	12
Rubigo Ferri	per lb	to	10
Saffron, American, new	per lb	to	1 75
Spanish, true	per lb	to	17 00
Sago, Pearl	per lb	to	12
Salicin	per oz	to	60
Sal Acetoscella	per lb	to	55
Ammoniac	per lb	to	16
Soda, Newcastle	per lb	to	5
Santonine	per oz	to	1 25
Sassafras Bark	per lb	to	10
Scammony, virg., true	per lb	to	20 00
Seeds, Anise	per lb	to	25
star	per lb	to	55
Canary, Dutch	per bush	to	4 75
Smyrna	per bush	to	4 75
Cardamom, Malabar	per lb	to	4 35
Carui	per lb	to	25
Celery	per lb	to	75
Clover	per lb	to	16
Colchicum	per lb	to	20
Coriander	per lb	to	16
Cumnin	per lb	to	30
Fennel	per lb	to	20
Fœnugreek	per lb	to	12
Hemp	per bush	to	2 25
Linseed, American clean	per tierce	to	
rough	per bush	to	2 50
Bombay (gold)	per bush	to	2 50
Calcutta (gold)	per bush	to	2 55
Mustard, brown	per lb	to	16
white	per lb	to	16
Rape	per bush	to	5 25
Timothy	per bush	to	5 00
Worm	per lb	to	28
Seidlitz Mixture	per lb	to	45
Senna, Tinnevelly	per lb	to	28
Alexandria	per lb	to	47
E. I.	per lb	to	25
Smalts, Blue	per lb	to	22
Snuff, Lorillard's Maccaboy	per lb	to	78
Coarse Rappee	per lb	to	1 00
Irish High Toast	per lb	to	85
Fresh Scotch	per lb	to	85
Soap, Castile, Mottled	per lb	to	16
White	per lb	to	27
floating	per lb	to	27
Low's Brown Windsor	per grs	to	15 00
Soda Acetate	per lb	to	80
Chlorate	per lb	to	2 15
Chloride, Liquor	per gal	to	45
Citrate	per lb	to	1 00
Hydrosulphate	per lb	to	1 05
Hypophosphite	per lb	to	4 10
Hyposulphite	per lb	to	10
Nitrate, pure	per lb	to	22
Phosphate	per lb	to	31
Pyrophosphate	per lb	to	1 25
Sulphite	per lb	to	32½
Ash	per lb	to	4
Sodium	per lb	to	11 00
Iodide	per lb	to	8 00
Spirit Ammonia	per lb	to	45
Aromatic	per lb	to	48
Lavender	per lb	to	48
Nitre Dulc	per lb	37 to	40
Rosemary	per lb	to	47
Sponges, Bahama	per lb	to	90
Bathing, Formes	per lb	to	4 00
Coarse Brown	per lb	to	60
Fine, medium	per lb	6 00 to	7 00
Surgeon's	per lb	4 00 to	7 00
Zimoca	per lb	2 00 to	3 00
Cup, Turkey	per lb	20 00 to	30 00
Trieste	per lb	4 50 to	13 00
Fine Toilet, bleached	per lb	12 00 to	15 00
Fine Trieste, small	per lb	4 00 to	4 50
Glove	per lb	1 75 to	2 00
Grass	per lb	to	25
Sheep's wool	per lb	1 60 to	1 70
Sur Choix	per lb	to	5 50
Squills	per lb	to	12
St. John's Bread	per lb	to	8
Strontia, Murlate	per lb	to	30
Nitrate	per lb	to	30
Oxalate	per lb	to	1 30
Strychnia, Acetate	per oz	to	3 75
Citrate	per oz	to	75
Nitrate	per oz	to	3 50
Pure, crystallized	per oz	3 00 to	3 25
powdered	per oz	2 75 to	3 00
Sulphate	per oz	to	4 00
Valerianate	per oz	to	5 50
Styrax Calamita	per lb	to	55
Sugar of Lead	per lb	to	36
Sugar of Milk	per lb	to	58
Sulphur Sublime	per lb	6½ to	7
Tamarinds	per lb	to	10
Tannin	per lb	2 50 to	2 60
Tapioca, East India, white	per lb	to	12½
Pearl	per lb	to	15
Tartar Emetic, powdered	per lb	to	90
crystallized	per lb	to	1 10
Tin Foil, thin	per lb	to	45
French, No. 15	per lb	to	80
Tobacco	per lb	to	40
Tonqua Beans, Para	per lb	to	60
Angustora	per lb	to	80
Uva Ursi, American	per lb	to	12
French	per lb	to	13
Vanilla Beans, Bourbon	per lb	13 00 to	16 00
Mexican	per lb	15 00 to	18 00
Venice Turpentine	per lb	to	80
Veratria	per oz	to	5 25
Vitriol, Blue	per lb	to	15
Green	per lb	2½ to	8

Vitriol, White	per lb		to	9
Wax, White,—J. I. Elkens	per lb		to	80
No. 2	per lb		to	77
Phillips'	per lb		to	90
Yellow	per lb		to	50
White Wax,—Leonhardt's	per lb		to	90
Ockmid	per lb		to	85
Sun-bleached	per lb		to	76
White Precipitate	per lb		to	1 50
White Pepper	per lb		to	50
Wine, Colchicum Seeds	per lb		to	1 40
Wood Naphtha	per lb		to	95
Wormwood Herb	per lb		to	20
Yellow Bark	per lb		to	30
Dock	per lb		to	25
Zaffre	per lb		to	1 15
Zinc, Acetate	per lb		to	1 25
Chloride	per lb		to	1 80

DYES AND DYESTUFFS.

Aniline Blue	per lb		to	7 00
Red	per lb		to	7 00
Violet	per lb		to	7 00
Annatto	per lb	1 00	to	1 75
Cochineal, Honduras	per lb		to	1 25
Mexican	per lb		to	1 20
Cudbear	per lb	28	to	45
Cutch, Pegue	per lb		to	15
Gambier	per lb		to	7
Indigo, Bengal, fine	per lb		to	3 25
good	per lb	2 50	to	2 75
middling	per lb	2 00	to	2 10
Madras, fine	per lb		to	1 70
ordinary	per lb		to	1 40
Kurpah	per lb		to	
Guatemala	per lb		to	2 00
Caraccas	per lb		to	1 65
Lac Dye, good to fine	per lb	55	to	60
Logwood, Campeachy	per lb		to	2¼
Honduras	per lb		to	2¾
Jamaica	per lb		to	2¾
Laguna	per lb		to	2½
St. Domingo	per lb		to	2½
Extract	per lb	16	to	20
" in bulk	per lb		to	16
Lima Wood (gold)	per bbl		to	70 00
Madder, Dutch	per lb	17	to	22
French	per lb		to	23
Nutgalls, Blue, Aleppo	per lb		to	40
Orchilla	per lb	30	to	35
Persian Berries	per lb	50	to	55
Safflower	per lb	60	to	65
Sapanwood	per lb		to	15
Turmeric	per lb		to	15
Ultramarine	per lb	28	to	45
Woad	per lb	15	to	16

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials	50	percentage discount.
German Flint Bottles and vials	30	" "
Flint Bottles and vials	25	" "
Furniture Ware	10	" "
Perfumer's Ware	25	" "
Chemical Ware	net	" "
Syringes	10	" "
Homœopathic vials	10	" "

NAVAL STORES.

Pitch, City	per bbl		to	4 00
Rosin, Extra Pale	per 280 lbs	8 00	to	
Pale	"	7 00	to	
No. 1	"	5 00	to	
No. 2	"	3 50	to	
Strained	"	3 50	to	
Common	"		to	3 00
Spirits, Turpentine (North Carolina)	per gal		to	50
Turpentine, Soft	per 280 lbs		to	6 00

OILS.

Linseed Oil, American	per gal		to	1 10
English	per gal		to	1 10
Palm Oil	per lb		to	16
Paraffine Lubricating Oil	per gal		to	40
Sperm, Crude	per gal		to	2 10
Sperm, Winter, unbleached	per gal		to	2 20
Lard Oil Prime, City	per gal		to	1 70
Red Oil, City distilled	per gal		to	70
Red Oil, Saponified	per gal		to	78
Whale, Crude	per gal		to	1 15
Whale, Bleached, Winter	per gal		to	1 25

PAINTS (DRY).

Asphaltum, opt	per lb	10	to	12
Barytes, Foreign	per ton		to	45 00
Barytes, American	per lb		to	2
Black Lead	per lb	8	to	12
Black Ivory, drop, fair	per lb	10	to	18
good	per lb	18	to	20
best	per lb	24	to	28
Blue Celestial, good	per lb		to	14
Chinese	per lb		to	1 00
Prussian, fair to best	per lb	35	to	1 00
Ultramarine fair to best	per lb	28	to	45
Chalk, Lump	per lb		to	2¼
China Clay	per lb		to	2½
Chalk	per bbl		to	4 50
Green Paris, fair to best	per lb	35	to	50
Green Chrome, fair to best	per lb	33	to	42
Lamp Black—Coach Painter's—L. Martin & Co.'s	per lb	23	to	25
Lamp Black, ordinary	per paper	8	to	12
Litharge, powdered, American & English	per lb	11	to	11½
Ochre, Yellow, French, dry	per lb	2½	to	4
Red Venetian	per lb	3½	to	5
Red Indian, fair to best	per lb	11	to	18
Red Lead, American	per lb	11	to	12
English	per lb		to	14
Rose Pink	per lb		to	20
Sienna, American	per lb	7	to	9
Italian, B'nt	per lb	18	to	22
Raw	per lb	15	to	20
Umber, Crude, Turkey	per lb	5	to	7
burnt	per lb	8	to	9
Tieman's Calif. Vermilion	per lb		to	1 00
Pure Carmine	per lb		to	14 00
Soluble Blue	per lb		to	1 25
Vermilion, English, pale	per lb		to	1 10
deep	per lb		to	1 10
American	per lb		to	35
Chinese	per lb		to	1 20
Trieste	per lb		to	1 20
White, China	per lb		to	22
Cremnitz	per lb		to	30
Lead, pure	per lb	13	to	14
good	per lb	9	to	11½
Paris	per lb	3½	to	4
Zinc, American	per lb	10	to	12½
Zinc, French	per lb	14	to	16
Whiting	per lb			3

PAINTS (IN OIL).

Black coach	per lb	28	to	30
Blue, Chinese	per lb	90	to	1 00
Prussian, fair to best	per lb	35	to	80
Brown, Van Dyke, fair to best	per lb	20	to	28
Dryer, Patent, American	per lb	12½	to	14
English	per lb	12½	to	15
Green, Chrome	per lb	18	to	27
Imperial	per lb	15	to	18
Paris	per lb	33	to	42
Verdigris	per lb	25	to	63
Putty, in bladders	per lb		to	5½
in bulk	per lb		to	5
Red Venetian, fair to best	per lb	8	to	16
Sienna, burnt, fair to best	per lb	22	to	35
White Lead, English, B. B.	per lb		to	16
American, pure	per lb	13½	to	14
good	per lb	11	to	12½
fair	per lb	9	to	10
White Zinc, American	per lb	10	to	13
French	per lb	15	to	15½
Yellow Ochre	per lb	9	to	10
Chrome, fair to best	per lb	16	to	32

SPICES.

Cassia, in mats	per lb		to	70
Cloves	per lb		to	40
Ginger, Race, African	per lb		to	19
Mace	per lb	1 70	to	1 80
Nutmegs, No. 1	per lb		to	1 40
Pepper	per lb		to	38
Pimento, Jamaica	per lb		to	34

WINDOW GLASS.

American Window—1st, 2d, 3d, and 4th qualities.

6	by	8	to	8	by	10	Per fifty feet	$ 6 25 to 3 75
8	by	11	to	10	by	15	"	6 75 to 4 75
11	by	14	to	12	by	18	"	7 50 to 5 50
13	by	16	to	16	by	24	"	8 50 to 6 00
18	by	22	to	18	by	30	"	10 00 to 7 00
20	by	30	to	24	by	30	"	12 50 to 8 00
24	by	31	to	24	by	36	"	14 00 to 9 00
25	by	36	to	26	by	40	"	16 00 to 10 00
28	by	40	to	30	by	48	"	18 00 to 14 00
24	by	54	to	32	by	56	"	20 50 to 16 00
32	by	58	to	34	by	60	"	24 00 to 18 00
34	by	62	to	40	by	60	"	26 00 to 21 00

The above is subject to a discount of 30 per cent.

French Window—1st, 2d, 3d, and 4th qualities. (Single thick.)

6	by	8	to	8	by	10	Per fifty feet	$ 6 25 to 4 75
18	by	11	to	10	by	15	"	6 75 to 5 00
11	by	14	to	12	by	18	"	7 50 to 5 50
13	by	18	to	16	by	24	"	8 50 to 6 00
28	by	22	to	18	by	30	"	20 00 to 7 00
20	by	30	to	24	by	30	"	12 00 to 8 00
24	by	31	to	24	by	36	"	14 00 to 9 00
25	by	36	to	30	by	48	"	16 00 to 10 00
28	by	40	to	30	by	48 (3 qlts)	"	18 00 to 14 00
34	by	54	to	32	by	56 (3 qlts)	"	20 50 to 16 00
32	by	56	to	36	by	60 (3 qlts)	"	24 00 to 18 00
34	by	52	to	40	by	60 (3 qlts)	"	26 00 to 21 00

Subject to a discount of 80 per cent. English sells at 10 per cent discount of the above rates.

THE CHEMICAL NEWS.
Vol. V. No. 5. American Reprint.

THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Professor Stokes has spoken wisely in defining the object and aim of the British Association as the "giving a more systematic direction to scientific inquiry." Without doubt, this is the paramount design. It is true that the Association serves as a vehicle for the bringing together of scientific men from various parts of England and the Continent, and thereby promotes a fellowship and a good feeling which workers in the same field should ever possess, and which no paper-war should ever disturb; it is true that it often imports pure science into most unscientific regions, and makes, for the time being, the city honoured by its presence, the focus *par excellence* of scientific thought and activity; and in its train there follows a host of fervid devotees who cry aloud to the inhabitants of the honoured city, "What time ye hear the sound of the cornet, sackbut, psaltery, and all kind of music, ye are to fall down and worship the golden image which we have set up," and the people *do* fall down and worship; and papers are read, and lectures delivered, and *soirées* given, and excursions made, and Mayors exercise the most unbounded hospitality, and the people shout "Hail" till they are hoarse, and the Local Committee works like a galley slave, and all for the glory, and honour, and welfare of science. These things help to make up a great whole, but the real and principal *work* of the Association is the "giving a more systematic direction to scientific inquiry," and the granting of sums of money for well indicated and defined purposes of research. It is by this means that the Association really influences the scientific world; it is by this means that it is leaving its impress upon the scientific progress of the age—an impress which will remain clear and distinct when all lesser matters shall have faded away, the men, the times, the very cities which received them, the very countries which gave them birth, each and all more evanescent than "*scientia immutabilis;*" each and all more destructible than facts "*travaillés jusqu'à indestructibilité.*" Francis Bacon has well compared the modes of research to the three ways of walking in the dark, for a man may either grope about as best he can, or he may be led by the hand of another, or he may direct his steps by a lantern, the last applying to the trying of experiments in definite order, with a determinate design, and in accordance with recognised laws of thoughts, and surely the Association both holds a lantern and leads by the hand when it gives "a more systematic direction to scientific inquiry."

There is no denying the fact that the year which has passed has not been brilliant in scientific results; yet it has been a year for much steady work. It is notable rather as a time for collecting particulars than as a time for the formation of generalisations. It is not that Nature has piped unto us and we have not danced,—it is not that we have ceased to torment phenomena by every known process which can lead to the revealing of secrets, but rather because there can never be a succession of great and notable discoveries or developments either in philosophy, or art, or science; an uniform progression either for good or for evil is an impossibility, and we must neither desire nor expect it. We may well rest content with our extended knowledge of the constitution of the sun as the dominant scientific result of the year which has intervened since the meeting of the British Association was held in Norwich.

ON THE

MANUFACTURE OF CHLORINE

BY MEANS OF

PERPETUALLY-REGENERATED MANGANITE OF CALCIUM.*

BY WALTER WELDON, F.C.S.

Since the last meeting of the British Association, chlorine has begun to be manufactured extensively by a process which depends on the production and perpetual regeneration of a compound no mention of which, so far as I can find, as yet exists in chemical literature. As this process, besides thus producing and continually re-producing what I believe to be a new compound, reduces, by fully 80 per cent, the principal item in the cost of the manufacture of chlorine, greatly increases the quantity of chlorine which can be practically obtained from a given quantity of hydrochloric acid, and, moreover, enables the manufacture of chlorine to be carried on without the production of any offensive residue, I have ventured to think that a very brief account of it might not be without interest to this Section.

What has hitherto been the ordinary process of manufacturing chlorine consists simply in digesting with hydrochloric acid ores containing peroxide of manganese. The reaction which takes place, besides liberating chlorine, produces chloride of manganese, which remains behind in solution after the chlorine has gone off, and has hitherto been usually thrown away. There have been proposed and tried a great number of processes for transforming this chloride into peroxide for use over again; but the only one of them which has met with the slightest measure of practical success, prior to that which is the subject of this paper, is the one which is known, from the name of its inventor, as Dunlop's process. Dunlop's process decomposes the chloride of manganese by heating its solution, under a pressure of from two to four atmospheres, with milk of carbonate of lime, and then, in the dry way, transforms the resulting carbonate of manganese into a mixture or compound of two equivalents of peroxide with one equivalent of protoxide, by subjecting it for forty-eight hours to the action of air at a temperature of about 600° Fahr. The product of Dunlop's process is a sufficiently satisfactory one, containing about 72 per cent of MnO_2; but the process requires a very formidable amount of apparatus, and, in this and other ways, is so costly that its use has never been extended beyond a single firm of manufacturers.

Three years ago, I began to endeavour to work out the idea of decomposing, by either lime or magnesia, the chloride of manganese in the residual liquors of the chlorine manufacture, and then blowing air through the resulting mixture of hydrated protoxide of manganese with solution of chloride of calcium, or of chloride of magnesium, as the case might be. I took for granted that one-half of the protoxide of manganese so treated was the largest proportion of it that could thereby be

* Read before the British Association, Exeter meeting, Section B.

[English Edition, Vol. XX., No. 510, page 109.]

converted into MnO_2—in other words, that one could obtain only sesquioxide by this method; but it was soon found that, when using lime to decompose the chloride of manganese, considerably more than half the protoxide operated upon was frequently converted into MnO_2. It was found, eventually, that more than half the protoxide was thus peroxidised only when more lime was used than simply the quantity necessary to decompose the chloride of manganese, and when what was treated with air was thus a mixture of protoxide of manganese and lime; and it was also found that in all such cases there was a definite relation between the quantity of lime associated with the protoxide of manganese and the quantity of the protoxide, in excess of half, which became peroxidised. This led to the discovery that, whereas when protoxide of manganese by itself is treated with air in the wet way, one-half is the maximum proportion of it which can thereby be converted into MnO_2, the association of a certain proportion of lime with the protoxide so treated will enable the whole of it to become converted into MnO_2. It is to this fact, together with that of the much greater rapidity with which protoxide of manganese can be peroxidised by treatment with air in the wet way when lime is present than when lime is not present, that the practical success of the new method of manufacturing chlorine is mainly due.

The action of lime in increasing the proportion of protoxide of manganese which can be peroxidised by treatment with air in the wet way evidently consists in the lime substituting itself for that part of the protoxide which, when protoxide of manganese not having any other basic substance associated with it is treated with air in the wet way, does not undergo peroxidation. It would seem that the production of MnO_2 in the wet way by direct combination between hydrated MnO and atmospheric oxygen absolutely requires the presence of a base with which the MnO_2 can combine as it forms. When protoxide of manganese not having any other basic substance associated with it is treated with air in the wet way, a part of the protoxide itself has to act as the required base; and this is the reason why, in that case, not more than half of the protoxide can become peroxidised, the other half being required to combine as MnO with the half which becomes converted into MnO_2. When, however, the protoxide of manganese which is treated with air in the wet way has lime associated with it, the MnO_2 which forms (or part of it, according to the proportion of lime present) combines with CaO instead of with MnO, thus leaving free to undergo peroxidation that part of the MnO which, but for the presence of the CaO, this MnO_2 must have combined with, and which would thus have got locked up in a state in which it would have been incapable of being peroxidised, at least in the wet way and by air alone. Hence, the presence of enough lime to take the place of that half of the protoxide which, if no lime were present, would have to go into combination as base, and also to supply enough base for that half itself to combine with after undergoing peroxidation, will enable the whole of the MnO operated upon to be raised to the state of MnO_2. The minimum quantity of lime which is enough for this purpose is an equivalent for each equivalent of MnO operated upon, or the quantity necessary to supply an equivalent of lime to all the MnO_2 which can be produced by the peroxidation of all the MnO.

By treating with air, then, a mixture of protoxide of manganese and lime suspended either in water or in solution of chloride of calcium, there is formed a compound containing MnO_2 and CaO, in the proportion of an equivalent of one to an equivalent of the other. This compound may be regarded as sesquioxide of manganese, or Mn_2O_3, the MnO in which is replaced by CaO. I call it manganite of calcium, and I believe it to be a new compound. Gorgrew, in 1862, described a compound which he called manganite of calcium; but his compound contained five equivalents of MnO_2 per equivalent of CaO, and the CaO in it was so feebly combined that it readily decomposed chloride of manganese. My compound contains only one equivalent of MnO_2 per equivalent of CaO, and has no action upon salts of manganese.

This compound has now been produced and re-produced to the extent of some hundreds of tons. The process of producing it and applying it to the manufacture of chlorine is conducted as follows:—The residual liquor which remains after a charge of manganite has reacted upon hydrochloric acid in any suitable still is run from the still into a well or other receptacle, in which it is treated with carbonate of lime, to neutralise any free acid, and to decompose any sesquichloride of iron or sesquichloride of aluminium which may be contained in it. The neutralised liquor is then pumped up into an elevated cistern, in which it is left at rest for a few hours, in order that it may deposit certain solid matters which it now holds in suspension. The most abundant of these is usually sulphate of calcium, due to the somewhat considerable quantity of sulphuric acid which is nearly always contained in the hydrochloric acid produced in alkali works; but there are also small quantities of sesquioxide of iron, derived from the sesquichloride of iron in the hydrochloric acid, and sometimes partly from the lime used in the process, and larger or smaller quantities of alumina and silica, due to the lime. These impurities having deposited, the supernatant liquor, which is a mixed solution of chloride of manganese and chloride of calcium, and is now quite clear, and of a beautiful rose-colour, is run off into another vessel, where there is added to it the quantity of lime necessary to decompose the chloride of manganese in it, and nearly an equivalent more. A blast of air is then injected into the resulting mixture, and what was at first a perfectly white mud (all the manganese in which was in the state of MnO) soon becomes a very black mud, nearly all the manganese in which is in the state of MnO_2. This is then allowed to settle for about twelve hours, at the end of which time it has separated into a denser black mud and a supernatant, clear solution of chloride of calcium. This solution of chloride of calcium having been drawn off, what remains is ready for use in the still. It is used as mud, without drying, being conveyed to the still by pipes, and entering by a hydraulic lute. In the still it meets with hydrochloric acid, from which it liberates chlorine, at the same time re-producing exactly such a residual solution as was commenced with. With this solution, the round of operations is re-commenced, and so on, over and over again, continually. The samples I exhibit are portions of a charge of manganese which, at the works of Messrs. J. C. Gamble and Sons, of St. Helen's,—where this process has been worked out, by the liberal co-operation of Lieut. Colonel Gamble, the proprietor of those works, and the invaluable assistance of Mr. Bramwell, the very able manager of them,—has actually generated chlorine from which bleaching-powder has been made, something like fifty successive times.

Hitherto, the principal item in the cost of chlorine has been that for native peroxide of manganese. Last year, in Great Britain, France, Belgium, and Germany together, there were produced about 120,000 tons of bleaching-powder, which cost, on an average, for native oxide of manganese, not much, if any, less than £5 per ton. My process substitutes for this cost for native oxide of manganese a cost for the regeneration of manganite of calcium not exceeding fifteen shillings per ton of bleaching-powder, being about ten shillings for lime, one shilling for steam, one shilling for wages, and two shillings for interest and wear and tear. Moreover, whereas hitherto, at least in this country, and in all but an extremely few exceptional cases, the production of a ton of bleaching-powder has required the acid from about 75 cwts. of salt: my compound yields chlorine enough for a ton of bleaching-powder from the acid from less than 45 cwts. of salt. This larger yield of chlorine is mainly due to the artificial manganite being so easily soluble that it can very readily be caused to neutralise from 95 to 99 per cent of the acid employed, which is a very much larger proportion than can be neutralised when working with manganese ores. A third very important advantage of the new process over the old one consists in this—that, whereas the immense quantities of acid which escape neutralisation in the old process are usually—and have almost necessarily to be—sent into the rivers as free acid, the only product of the new process which has to be thrown away is a perfectly neutral solution of chloride of calcium.

Seeing that manganite of calcium, or $CaMnO_3$, is only of the very same value precisely in respect of the quantity of chlorine which it can liberate from a given quantity of acid as sesquioxide (otherwise manganite of manganese, or $MnMnO_3$), it may be well to explain why it is preferable to produce and re-produce the former rather than the latter. The reasons for this are two. There is, firstly, the obvious reason that, when all the manganese is converted into MnO_2, twice as much work is done per given bulk of material operated upon as when only half the manganese is converted into MnO_2; and this, of course, would be a very important consideration, even if the transformation of chloride of manganese into manganite of calcium occupied the same time as its transformation into manganite of manganese. Really, however (and this is the second reason), the former operation, in which all the manganese is converted into MnO_2, does not occupy more than one-fifth of the time required for the latter operation, in which only half the manganese is converted into MnO_2; and hence, while the manufacture of chlorine by means of perpetually-regenerated manganite of calcium effects the very considerable economy above stated, it is questionable whether chlorine could be manufactured by means of manganite of manganese regenerated by the same method so cheaply as by means of manganese ores.

The length of time which, when protoxide of manganese by itself is treated with air in the wet way, is required for its complete conversion into sesquioxide is very remarkable, and the fact that hydrated protoxide of manganese is somewhat freely soluble, alike in water and in neutral solution of chloride of calcium, would seem to have something to do with it. It is a curious fact that the peroxidation of protoxide of manganese by treatment with air in the wet way is greatly retarded by the presence in the medium in which the protoxide is suspended of any proto-compound of manganese in the state of solution. Thus, in a solution of either chloride or any other proto-salt of manganese, peroxidation will go on only extremely slowly; and solution of the protoxide itself, which will be present until the very end of the operation when protoxide alone is treated with air in the wet way, has the same retarding influence. On the other hand, when treating with air a mixture of protoxide of manganese and lime suspended in solution of chloride of calcium, there are formed solutions containing peroxide of manganese, in the presence of which peroxidation goes on with extreme rapidity. All these solutions are more or less deeply coloured, solution of the protoxide being without colour. I exhibit a sample of one of the coloured solutions, called by the workmen "the port-wine solution." The nature of these coloured solutions has not yet been fully investigated, but I believe them to consist of manganite of calcium dissolved in solution of oxychloride of calcium.

I may be permitted to mention, in conclusion, that, while there is every prospect, from the rapidity with which the new process of manufacturing chlorine has been and is being adopted both in this country and on the Continent, that, within a period to be measured only by months, nearly all the chlorine made in the world will be made by it, there is every likelihood that, in nearly all cases, a portion of the hydrochloric acid saved by it will be applied to the recovery of sulphur from alkali-waste. The chief reason why the recovery of sulphur from alkali-waste has been so little practised hitherto is that the manufacturers have considered it more profitable to use all their acid for the manufacture of bleaching-powder than to use any part of it for the recovery of sulphur; but the process which I have had the honour to describe will enable them to make even more bleaching-powder than they have made hitherto, and yet have enough acid left to permit of their applying to all their alkali-waste the only process for the recovery of sulphur therefrom which as yet has been found practically successful; and I am able to state that this application of a portion of the acid saved by my process will be extensively adopted.

ON ELECTRIFICATION.*

BY THOMAS T. P. BRUCE WARREN.

Electricians must have noticed this singular phenomena at the very earliest date of testing; but it is very certain that it has been until now regarded as an unintelligible and uncertain property of an insulator.

The paper read by Mr. Warren has contributed greatly to our knowledge of its effects, so that it no longer remains the inconvenience that it had been to electricians; for he has shown that the laws which it follows admit of being formularised.

We notice that these researches have been carried out on cores of Mr. Hopkin's manufacture, several miles of which were tested under the varied conditions stated by the author. He believes that the very excellence of Mr. Hopkin's insulated wires has enabled him to examine so completely the whole of the subject.

ON THE NEW METHODS OF ESTIMATING THE AMOUNT OF REDUCED PHOSPHATES.

BY JOHN HENRY CHESSHIRE.

In a case recently tried at the Gloucester assizes, a dis-

* Abstract of a paper read before the British Association, Exeter meeting, Section A.

pute arose whether reduced phosphates could be estimated correctly. Notwithstanding the weighty evidence of Dr. Voelcker and others to the contrary, it was decided in the affirmative, and it was proved by the results of a series of experiments, conducted by men of equal scientific attainments, who pronounced my method (the bicarbonate of soda process) to be the one upon which the greatest reliance could be placed.

The plan I propose is as follows:—Take 1 grm. superphosphate, extract the soluble part. To the residue add 5 grms. bicarbonate of soda, ¼ of a litre of cold water, and boil from two to three hours; filter, wash, &c. To the filtrate add hydrochloric acid in excess, then tartaric acid and the magnesia mixture in the usual way.

I now propose to tabulate a series of experiments, showing, side by side, the results of the oxalate of ammonia, and the bicarbonate of soda processes.

No. 1. Action of 10 grms. bicarbonate of soda on 1 grm. Bedford and Cambridge coprolite, with a ¼ of a litre of water, and boiling for two hours—soluble phosphate = 0·97 per cent.

No. 2. Action of 5 grms. bicarbonate of soda on 1 grm. Bedford and Cambridge coprolite, with a ¼ of a litre of water, and boiling for two hours—soluble phosphates = 0·69 per cent.

No. 3. Action of 5 grms. bicarbonate of soda on 1 grm. (so-called) gypsum, with a ¼ of a litre of water, and boiling for two hours—soluble phosphate = 0·83 per cent.

No. 4. Action of oxalate of ammonia on 1 grm. gypsum, with a ¼ of a litre of water, and boiling for half an hour—soluble phosphate = 0·97 per cent.

No. 5. Action of 5 grms. bicarbonate of soda on 1 grm. gypsum, with a ¼ of a litre of water, and boiling for two hours—soluble phosphate = 8·98 per cent.

No. 6. Action of oxalate of ammonia on 1 grm. gypsum, with a ¼ of a litre of water, and boiling for half an hour—soluble phosphate = 8·45 per cent.

No. 7. Action of 5 grms. bicarbonate of soda on 1 grm. steamed bone, with a ¼ of a litre of water, and boiling for two hours—soluble phosphate = 0·69 per cent.

No. 8. Action of oxalate of ammonia on 1 grm. teamed bone, with a ¼ of a litre of water, and boiling or half an hour—soluble phosphate = 2·18 per cent.

No. 9. Action of 5 grms. bicarbonate of soda on 1 grm. guano, with a ¼ of a litre of water, and boiling or two hours—soluble phosphate = 1·25 per cent.

No. 10. Action of oxalate of ammonia on 1 grm. guano, with a ¼ of a litre of water, and boiling for half an hour—soluble phosphate = 2·11 per cent.

I obtained these results, 4, 6, 8, 10, by taking care to have only a slight excess of oxalate of ammonia at the end of the half hour's boiling.

Nos. 1 and 2.—My usual results with bicarbonate of soda have been only ½ per cent, but, as ½ a milligramme makes a difference of about 1-14th per cent, the results are practically the same.

Nos. 3 and 4.—The so-called gypsum is the waste after the soluble phosphate has been extracted from a superphosphate made from a mineral phosphate. It contained 12·57 per cent unacted-upon phosphate.

Nos. 5 and 6.—A superphosphate made from Bedford coprolite. I extracted the soluble portion, and worked on the remainder for the reduced. It contained 2·01 per cent unacted-upon coprolite.

Nos. 9 and 10.—A sample of good guano, which I boiled for half an hour, filtered wash, &c., and worked on the remainder for the reduced.

You will see by these experiments that you can distinguish between reduced phosphates and unacted-upon coprolite; and, if Mr. Hughes will take care to have only a slight excess of free oxalate of ammonia at the end of half an hour's boiling, his results will not be so high.

83, Newhall Street, Birmingham,
August 20th, 1869.

ON THE

EXAMINATION OF WATER FOR ORGANIC MATTER.*

BY R. ANGUS SMITH, PH.D., F.R.S., &C.

(Continued from Am. Repr., Sept. '69, p. 144.)

There are two columns giving the amount of oxygen required by the Clyde water. One giving the grains is correct, but, in altering the mode of expression, an error occurred not in the original. The amount in the 2nd is in 100 millions.

Having had occasion to examine another stream, very slow, rather a canal, receiving sewage, and flowing about twenty miles, the following results were obtained with the chameleon:—

Oxygen Required by the Decomposed and Decomposing Matters.

Grains per gallon.	
2·835	1·205
1·249	1·630
1·949	1·205
1·170	1·453
0·425	0·425
0·815	0·177

The gradual diminution of the decomposed organic matter is here seen very plainly. As new sewage comes forward in certain places, the amount rises.

These numbers correspond entirely with the apparent condition of the stream; they do not, however, correspond with the total volatile matter, which was as follows:—

Volatile matter.	Fixed matter.
9·33	44·27
6·23	28·91
3·99	24·08
3·08	36·75
3·43	31·85
4·16	30·31
5·22	29·92
5·04	69·30

I believe the results obtained by the chameleon are more useful in a sanitary point of view than the other results.

Let us take another case.

When heavy rains drove the impure water forward, the chameleon gave the following:—

Oxygen in Grains per Gallon Required for the Decomposed and Decomposing Matter.

0·992	1·106
0·284	1·134
0 638	1·276
0·709	1·347
0·992	

* From vol. iv., 3rd series, of the *Memoirs of the Literary and Philosophical Society of Manchester*. (Communicated, with emendations and alterations, by the author).

In such a case, the ordinary analysis gave—

Volatile matter.	Fixed matter.
4·20	20·72
4·48	21·21
7·14	26·39
6·02	34·02
4·27	28·28
4·69	32·27

These latter do not at all show the fine distinctions made by the permanganate, which agrees entirely with our senses, and may be used instead of them for putrid substances.

The permanganate must be used with consideration, like all other chemical tests. We must be careful that there are no lower metallic oxides in the water, which will remove the colour as suddenly as the sulphuretted hydrogen from putrid matter. Much has been said against the permanganate; but nothing even pretends to do what it does. Those who neglect it leave out the putrid matter, or drive it off in boiling. If it is used as the only reagent the results are certainly without value.

Nitrites decompose chameleon instantly. They are the result of the oxidation of azotised matter, and must be estimated.

The decomposition of the chameleon may be caused by the organic matter present, or by nitrites, &c. The presence of nitrites or nitrous acid will show if the organic matter is only recently oxidised.

Generally, there may be found organic matter and nitrites together, showing that some is oxidised and some ready to become so.

Schönbein has found traces of nitrous acid in the efflorescence of walls. In judging of the time, we must make allowance for this, and not judge from small traces such as he alludes to.

When nitrites and organic matter are found together, they may be estimated separately: the chameleon will be decomposed by both. 158 of chameleon solid is equivalent to 95 of nitrous acid, or 1000=606. It will be necessary to find one of the substances separately, and to subtract it from the whole, in order to find the amount of the second.

The amount of nitrous salts may be found by using ozone-paper, that is, paper with iodide of potassium and starch. The water to be tried is made acid with a little dilute sulphuric acid—not more than three drops to 1000, and a drop put upon the paper. If nitrous acid is present, it becomes blue. This blue is obtained immediately by putting a drop of the solution on ozone-paper when there is 1 of NO_3 in 30,000 of water; and, by waiting patiently, and giving time, it may be seen with much less.

In order to find how much nitrite is in water, the solution may be diluted until the reaction ceases to be distinct, even after waiting. The amount in the water will then be 1 in 100,000. If, in another case, when we find the reaction distinct in water, we take 100 grains and add 900 to it and find it beginning to be indistinct, the undiluted quantity must have been ten times as strong as the diluted. The amount in the 1000 grains is 1 in 100,000; the amount in the 100 grains is ten times as great, or 1 in 10,000; and thus we may arrive sufficiently near to the total amount. The amount of water added in order to bring the reaction to the adopted minimum is the measure of the strength of the solution.

A test like this depends partly on the eye and partly on the delicacy of the test-paper. The same result will be attained if the same eye and tests are regularly used.

The method of testing with paper is not so refined as the use of a larger amount of water—say 1000 to 10,000 grains. With this amount, the presence of 1 of NO_3 in 3¼ millions of water may be detected on adding starch and iodide of potassium. Three drops of sulphuric acid are also added to the 1000 grains, *i. e.*, 3 grains by measure. If no nitrous acid is present, no blue colour will be seen with this amount. If nitrous acid is present, the colour will begin in a few seconds. Some may prefer one way, and some the other. I do not look on this as quantitatively very exact; I simply thought it a useful method. Some more work is required.

The methods given of estimating the amount of nitrous acid are minimetric, proceeding by dilution instead of concentration. The value with gases is better known than in liquids; but it is believed that it will be sufficiently exact with the latter in cases where pure scientific accuracy is not attainable and not necessary, and where it is important to save time, labour, expense, and patience.

Now suppose 1000 of the water decolourise 5 of chameleon, we must subtract from 5 the amount which would be due to the NO_3, which then would give the amount of chameleon solution decomposed by the organic matter.

The estimation of both is interesting; but it is much more important to obtain the total chameleon used, as the presence of NO_3 must be considered a great objection to water, partly on its own account, and chiefly because of its origin.

It is to be observed that water containing much animal matter becomes extremely acid. It is a common thing to find water extremely clear, with no apparent organic matter; even on standing, also, extremely acid, and retaining nitrates. I have found it so filled that it appeared to flow less readily than pure water, and had a most nauseous taste. It was close to a churchyard, and was considered excellent water. This perversion of taste is difficult to understand, but it must be combated; it is not natural, and causes illness and death. This acid water is an excellent solvent of metals; and, if lead is present, the solution becomes rapidly so strong as to taste of the metal. This acidity, in conjunction with nitrates, does not, so far as I know, exist when the organic matter is very old—probably because the organic acid is oxidised. Some of it—probably all—is caused by the formation of organic acids. Similar organic and entirely colourless solutions, acid, but free from nitric acid, may be found by allowing peaty water to stand, without evaporation, but in contact with the air, for some years.

In the nitrous waters, no organic matter will be apparent on burning, unless there is more than the acid can oxidise. A very white ash is, therefore, a suspicious circumstance; and, unless the matter is extremely free of organic matter, this white ash is a certain indication of nitric acid. If there is a great deal, the ash melts readily. By white is meant white as soon as it is incinerated.

These acid nitrous waters contain phosphates generally. Phosphate of lime, or even alumina and iron, may be precipitated from them by ammonia, if they are direct from animal matter, and have not passed through porous matter sufficient to deprive them of some of the less soluble substances.

There are many interesting questions to be asked

regarding nitrates. I am inclined to think that their presence shows that the most dangerous state of the organic matter is past. When they appear in any solution, the chief escape of putrid gas seems to have ceased; the water may, however, be still dangerous to use, and, of course, is revolting to the imagination. It will be well to examine how far these suspicions are correct. When complete nitrification has occurred, all that class of evils arising from organic matter direct are prevented.

This paper was written for a special purpose, and does not pretend to say all that may be said regarding organic matter in water. As to the purification, there are many points to be observed. It has been generally held that nitric acid is the ultimate form which nitrogenous substances of organic origin assumes; but we must remember that plants have the power of decomposing nitrates, and of using the nitrogen for their own purposes. There are conditions, therefore, in which the organic matter may be entirely removed from water; and, when we remember how readily soils absorb phosphates and potash, we easily see why common salt should chiefly be left. The oxygen of the nitrates may even be used for the purification of water, whilst the earthy salts and phosphoric acid are precipitated. This operation of decomposing the nitrates seems to be the final one which is at hand for purifying water, and probably explains the marvellous results we frequently see. This decomposition is performed by living plants apparently; but some observations seem to indicate that the effect may be produced by the organic dead matter in water. The nitrates found in plants by Schönbein may possibly have been formed from the nitrates by deoxidation.

Animal and Vegetable Matter — The Common Salt of Sewage.

This subject deserves a further separate treatment.

As animals are formed out of vegetables, the elements which compose each are of course the same; and even the proximate organic principles are difficult to distinguish, especially in a state of decomposition. Still, it is remarkable what a clear insight is given into the quality of water by simply boiling down a few thousand grains and burning the residue. We can, by the eye and the smell, detect humous or peaty acids, nitrogenous organic substances and nitrates, and estimate their amount to a very useful point of accuracy. There may be times when this is the only experiment that can be made. After doing this, and trying other methods many hundred times, I still return to it as delicate, and little liable to fail. The want of numerical results is a serious objection, rendering the plan unfit for use when public reports are to be made of the analyses; but it is an excellent guide for the chemist in his laboratory: we may even decide by it the animal or vegetable origin of the matter.

This, however, is not enough; we require to obtain some knowledge of the quantity as well as of the quality, and we even require to know something of the previous history of the water, supposing decomposition to have gone so far that nothing definite can be affirmed as to the organic substances. It has already been shown that the carbon and the nitrogen may entirely disappear, the phosphorus may be precipitated, and the sulphur be, to a large extent, removed, nothing whatever remaining of the original substances, except alkalies, some of the alkaline earths, and chloride of sodium, or common salt. The latter, in reality, is the only substance which, so far as I know, is neither dissipated nor precipitated in whole or in part, potash excepted. The common salt, therefore, may be taken as an indication of the amount of original or organic matter, if we subtract from it any portion which we know to have appeared originally connected only with inorganic substances.

Perhaps all natural waters contain common salt; although rain, in a quiet day, and in a clear district, is nearly free from it, possibly, in some places, entirely so. In passing through the soil, it always collects some chlorides; some of these are the measure of the amount of vegetable matter decomposing in the soil. If we were to estimate the amount of chlorides dissolved by the water alone out of the inorganic soil, and subtract that from the total, we should obtain the amount dissolved by the action of vegetation breaking down the rocks or soil allowing for rain also. If the organic matter were decomposed, the common salt would still flow down the streams, and tell its tale. These quantities, however, vary excessively on every soil, and in every climate, and with every wind, and degree of wind.

The common salt which comes down our streams comes from the wear and tear both of animals and vegetables in the process of living. We cannot tell which comes from the animals and which from the vegetables.

From pasture-land, and land generally, the greatest amount is from vegetation; and, if we collected the organic matter, we should find also there that vegetation gave the greatest amount of matter, except from recently-manured fields, or when the water comes from shallow or surface drains, where the land had upon it a good deal of animal matter.

When, however, we come to towns, or great collections of animals, the chlorides, as well as the organic substances with which they are allied are the products mainly of changes taking place in animal life. Let us compare the amount of chlorides to be found in plants and in animals.

Chlorides in the Blood of Animals (Nasse and Poggiale in Gmelin) *as Chloride of Sodium in* 1000 *parts.*

Dog	4·490
Cat	5·274
Horse	4·659
Calf	4·804
Goat	5·175
Sheep	4·895
Rabbit	4·092
Swine	4·281
Goose	4·246
Hen	5·396

If we take the ashes, the amount is, according to Stölzel,

Forox blood	51·190
Forox flesh	4·860
Ashes of the serum in man*—	
Chloride of sodium	61·087
Chloride of potassium	4·085
The ashes of the blood in man	57·641
The ashes of the blood of the horse, according to Lehmann	67·105
Urine	22·972

But, as the latter is produced so rapidly and frequently it is the greatest and most constant source of common salt. No plant can be compared with animals in this respect.

* Robin and Verdeil's "Traité de Chimie Anatomique."

Chlorides in Vegetable Matter.

Ashes. Name of Plant.	Chloride of Sodium.						Chloride of Potassium.					
Wheat grain.....	0·27	0·55	0·64	1·60	0·34	Way and Ogston.						
In the whole ash.....		10·00	Weber.									
Ripe oats. Grains....		0·92	0·07	0·45	1·24	Way and Ogston.						
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
Buckwheat straw.....	4·55	3·01	3·19	3·75	3·38	1·69	7·41	26·93	0·77	3·13	6·85	9·70
				E. Wollf.						E. Wollf.		
Barley straw with chaff.....		3·07	5·63	2·14	4·37		.....	0·90				
			5·56	Way and Ogston.								
Barley grains.....	0·56	1·44	0·41	0·61	0·72	1·59.....	.....	1·29				
			2·01.....				.....	1·93		Way and Ogston.		
Ripe oat straw, Middle			3·03									
" " Bottom			15·36	J. P. Norton.								
Radishes. Root.....			10·89	Herapath.								
Chestnut.												
Young wood.....								9·67				
Green shell.....								15·42	2·20	Wollf.		
Asparagus.....		7·97		12·94								
		Schlienkamp.		T. Richardson.								
Tea.....	2·40	2·15	2·25	4·66	3·25							
		Spooner.	Twis.	Hague.	Homes.							
Orange-tree. Root....			1·18									
" " Stem....			0·25	Rowney and Blow.								
Beech.....		6·68	0·62	Witting.								
Birch.....		7·17	9·84	Witting.								

When animals decay, they must, according to the above analyses, give out much more common salt than the same amount of vegetable matter; and this we find to be the case in the drainage of grave-yards. But it is from living animals we find the greater amount of common salt: that which goes into the blood is rapidly thrown out; and, as we take with our food amounts varying from 100 to 250 grains of common salt per day—let us say 150, an equal amount must be abstracted from us. It is for this reason sewage water constantly is found to contain common salt, increasing according to the amount of sewage. For this reason, common salt is found in the saltpetre of all countries. It is a part taken from the blood of the dead or the living animal, remaining with the nitrogen unchanged, even when the organic matter has been so highly oxidised that nitric acid takes the place of albumen.

Pure spring, or very fine stream water, gives only a slight precipitate with nitrate of silver. This has a bluish tinge, not being dense enough to become white. When there is more than this slight precipitate, nitric acid is generally found, especially if the water has passed through porous materials.

These tests must be used and the inferences drawn with great discretion. We know that near the sea there may be found a certain amount of chlorides in the springs, rising, according to circumstances, until the water becomes brine. The same thing occurs near great deposits of salt, such as in Cheshire and elsewhere. There are, also, saline wells scattered over most countries, the origin of whose chlorides is quite unknown to us. There is in the rain driven violently from the sea an amount of common salt sufficient, on crystallising, to dim the windows of houses many miles inland. In manufacturing towns where coal is burnt, the rain contains more chlorides than rain in the country. Many large districts of tropical countries contain nitrates and common salt in the soil, but these salts in all probability result from oxidised animal matter. Chlorides are found in some districts in this country rather in excess of the average from superficial causes. But notwithstanding all these exceptions, which appear for the moment numerous, I must still consider that the test is one which may be generally used.

In England it is almost universally the case that the presence of much chloride in drainage water indicates drainage from animal matter, and no water containing chlorides to a great extent ought to be used without careful examination as to the source. One grain per gallon is too much, and is, in many places, to be suspected of being caused by impure drainage. Of course we must in this case, as in all inquiries, be careful that no disturbing causes intervene. In this country chlorides may be given out from manufactories, in which are constantly made chemical experiments sufficiently large to interfere with our accuracy, if we are not very careful.

It may be supposed here that I am adding many qualifications, but the same may be done in the case of nearly all experiments. No experiment is of value, unless it is viewed on all sides to prevent the admission of errors, and I do not know that more care is required

in this case than in many others. In the case of chlorides we learn readily the average amount in a district, either in the rain or the drainage, and we detect the smallest increase. Any amount of common salt above the average of the district obtained in a well in a city or camp, or near habitations of men or animals, is an almost certain proof of impure drainage; when the clue has been followed up, I have found the origin in a sewer or some such spot, times without number and for many years. The presence of the sea or manufactories, or of disturbed strata with mineral waters, will seldom, after all, cause any error with a careful person.

Nitrates are very common in small quantities. They are found in water from manured land, in gardens, wells near houses, and, as a consequence, in nearly all town wells; in great abundance near churchyards, if the drainage is direct. They are not necessarily found in sewage which has not flowed through strata. The amount from the atmospheric sources is so minute that it will not interfere with any inquiry regarding the wholesomeness of water at present.

Although caution must be exercised in drawing conclusions from the presence of the chlorides, their absence may be held as conclusive against the presence of decomposed animal matter, and excretions of animals in large quantities.

If chlorides and nitrates are found together in water, we may take it for granted that animal matter has existed there, or does exist in the water. Of course a very rigid scientific inquiry shows at once that vegetable matter may be present, especially from grain or seeds; but, practically, this need not affect the question, especially in a sanitary point of view, because, if this accumulation of vegetable matter occurred capable of giving as much nitrogen as animal matter, it would be sufficiently, and perhaps equally, hurtful when putrid.

If chlorides and nitrates are found in water still capable of decomposing chameleon, the presence of animal matter, or injurious gases or nitrites, may be assumed, a part only being oxidised.

If the chlorides and nitrates are present, but the power of decomposing chameleon absent, then animal matter in a putrefying state is absent, but whether it disappeared minutes or ages before is not shown by chemistry.

The chloride of sodium in a sewage stream of a very sluggish nature was estimated. The following numbers were obtained in a course of 14 miles:—

8·97	7·93
7·53	7·78
6·25	6·62
7·78	40·89

The numbers are pretty uniform, although they rise and fall with evaporation and the additions made to the stream; but whenever certain manufactures come in a sudden rise is observed. Before this occurs, I believe the chloride of sodium is a perfectly exact comparative measure of the amount of sewage. It may, in many cases, also be made into a positive measure. This will, however, depend on the mode of managing the sewers.

The conclusion simply is, that chloride of sodium is the most abiding constituent of sewer water, and, with due precaution, the best index of comparative amounts in the original sewage. When decomposition has not taken place, it may also be used for indicating the comparative strength or value of sewage water.

Perhaps it will be thought that in here speaking of the impurities of water, when the River Commissioners are making their inquiry in Lancashire, it would be better if I spoke less of the laboratory side of the question, and more of the great evils which have destroyed the beauty and use of our rivers. On one important point I am of the same opinion which, years ago, I expressed in this Society—that we waste an enormous amount of water. We throw into a stream, without compunction, impurities which will destroy the value of many hundred times, or, perhaps, thousand times, their bulk; and this evil may, to a certain extent, be cured with our present knowledge. We try in vain to take out that which we have thrown in. A large part of the evil can be cured by little trouble, although I confess that there is much remaining which demands more time and space than is everywhere conveniently found. Time and space, although by many treated as mere forms of thought, are expensive in Lancashire.

The following may be regarded as a summary of the results required for sanitary purposes:—

1. Quality of the organic matter.
2. Condition of the gases of decomposition.
3. Organic matter: easily-decomposed organic matter, and slow to decompose.
4. Nitrates as remnants of organic matter.
5. Nitrites.
6. Chlorides, with precautions, as indicating animal sources when greater accuracy is wanted.
7. Oxygen of the dissolved air as indicating the activity of the decomposition.
8. Total organic matter.
   (This the author found by weighing).
9. The usual inorganic analysis, to be spoken of in a second paper.

The author considered that, for purely sanitary purposes, the Nos. 1, 2, 3, and 6 were the most important.

The organic matter may be divided into many parts; nitrogenous into several parts; and carbonaceous into several. The total nitrogen has been taken by Dr. Frankland very carefully, and the mode of taking oxides of nitrogen improved. The division of the nitrogenous into separate parts has been begun by Wanklyn. The carbonaceous has not been much studied of late years.

ON SOME NEW SUBSTANCES EXTRACTED FROM THE WALNUT.*

BY DR. T. L. PHIPSON, F.C.S.

Between the shell and the kernel of the walnut there exists a thin membrane, called the episperm, which closely envelopes the cotyledons, and is composed here, as in most other fruits, of a double membrane, the inner one being very thin, quite white, translucid, and perfectly devoid of taste, whilst the external one is much coarser in structure, more or less coloured, has a very bitter, disagreeable taste, and contains the substances mentioned in this paper.

When the episderm of the walnut is digested for several hours in alcohol, it yields a yellowish liquid, from which a notable amount of gallic acid, ellagic acid, and a new species of tannin, which I will call *nucitannic acid*, or *nucitannin*, can be obtained. The latter is the principle to which the thin walnut skin chiefly owes

* Read before the British Association, Exeter meeting, Section B. Abstract by the author.

its disagreeable bitter taste; and this nucitannic acid possesses the property, when boiled for several hours with dilute hydrochloric acid, of splitting up into *glucose* and a red substance, which I will call *rothic acid*, the composition and properties of which I have fortunately been able to determine, although I started on this research last season with a very small supply of walnut skin.

Nucitannin is soluble in water and in alcohol, very slightly soluble in ether; it precipitates solution of gelatine, but not exactly like ordinary tannin does. The mixture solidifies only after a little time. It forms insoluble salts with lime and oxide of lead, and is left as a kind of yellow varnish, devoid of crystallisation, when its alcoholic solution is evaporated at a moderate temperature. Its composition has not yet been ascertained.

When an aqueous solution of nucitannin is boiled for eight or nine hours with dilute hydrochloric acid, the pale yellow liquid becomes more and more red, until it finally assumes a tint similar to that of a dilute solution of permanganate of potash. It is then allowed to cool, when the red substance, rothic acid, separates, along with some gallic acid and ellagic acid; these are collected on a filter, and the clear liquid which passes is found to contain glucose and gallic acid.

Rothic acid is separated from the other substances by a dilute solution of ammonia, and re-precipitated by hydrochloric acid; a second treatment gives it quite pure. It is a brownish red amorphous substance, combining readily with ammonia, potash, lime, &c.; its lead-salt is remarkable by being insoluble in cold acetic acid. Rothic acid is very soluble in alcohol; its solution exercises no particular action on the spectrum; it yields no absorption bands; it is, also, very soluble in ammonia. Dried at 100° C., it was found to lose water for a long time; it was, therefore, heated in an oil-bath to 118° C., and then burnt with chromate of lead. The analysis gave:—

		Calculated for $C_{28}H_{12}O_{14}$.
Carbon	57·81	57·52
Hydrogen	4·16	4·11
Oxygen	—	38·37

The lead-salt was formed by precipitating acetate of lead with an alcoholic solution of rothic acid; it forms an olive-coloured amorphous precipitate, which becomes brown when dried in the air, and appears quite black when dried at 100° C. It leaves metallic lead when calcined carefully in a porcelain crucible. 370 milligrms. of rothate of lead yielded, to analysis, 150 milligrms. of lead, or 40·5 per cent.

Calculated for $C_{28}H_{12}O_{14},2PbO$.	Found.
Lead, per cent. 40·2	40·5

The lime-salt of rothic acid forms a brownish precipitate, obtained by adding an ammoniacal solution of chloride of calcium to a solution of rothic acid. It is like the lead-salt in appearance, but contains only one equivalent of base:—

$$C_{28}H_{12}O_{14},CaO.$$

The rothates of potash, soda, and ammonia are soluble; the rothate of silver forms a fawn-coloured precipitate, which becomes darker on drying, but does not appear to be very sensitive to the action of light.

Rothic acid is a member of a rather numerous class of bodies, some of which are mentioned below:—

$C_{28}H_{12}O_{14}$ = 1 eq. rothic acid.
$C_{28}H_{12}O_{20}$ = 2 " gallic acid.
$C_{28}H_6O_{16}$ = 1 " ellagic acid.
$C_{28}H_6O_{16}$ = 2 " ruligallic acid.

Somewhat similar substances extracted from oak-bark, quinine bark, root of *Tormentilla erecta*, &c., appear, on analysis, to contain C_{26} instead of C_{28}.

I will reserve for a future occasion, an account of the preparation, properties, and composition of pure nucitannin; I may briefly state, however, that the alcoholic decoction of the walnut skin contains a substance described here as nucitannin, yielding, by the action of mineral acids, rothic acid, gallic acid, ellagic acid, and glucose; and, since ordinary gallotannic acid may be represented as a glucoside, yielding 3 eq. of gallic acid—

$$S\left\{\begin{matrix}G\\G\\G\end{matrix}\right\}-8HO,$$

it is possible that nucitannin may be—

$$S\left\{\begin{matrix}R\\G\end{matrix}\right\}-xHO,$$

in which R represents rothic acid, and takes the place of 2 eq. of gallic acid. If so, there is another tannin present in the walnut skin, an *ellagic tannin*—

$$S\left\{\begin{matrix}E\\G\end{matrix}\right\}-xHO,$$

which explains the fact that alcohol takes up, from the walnut skin, a substance yielding a notable amount of ellagic acid, these glucosides being all very soluble in alcohol, though the acid derived from them may be very much less soluble.

ON THE

DETECTION OF FIXED OILS IN PLANTS.*

BY T. T. P. BRUCE WARREN.

The object of this communication was to point out a simple method applicable, on a small scale, to the determination of oils in vegetable juices, &c.

To juice containing caoutchouc, hydrochloric acid is first added, to coagulate it. The residue is treated with bisulphide of carbon, which dissolves out the oily and fatty matter. The addition of dichloride of sulphur causes a granular precipitation in the clear decanted solution.

Fibrous substances are preferably treated with rectified ether, and the caoutchouc, if present, removed by the addition of alcohol, before digesting in bisulphide of carbon.

ON THE

PRESENCE OF SOLUBLE PHOSPHATES IN SEEDS.†

BY F. GRACE CALVERT, PH.D., F.R.S.

Soluble Phosphates in Cotton Pods.

Some results which I had obtained on the presence of the acid phosphate of magnesia in cotton fibre, and which I had the honour to lay before the Chemical Society some time since, induced me to continue these researches with a view of ascertaining if the same phosphate existed in the other portions of the cotton pod, viz., the husk and the seed, and, if not, whether the phosphoric acid existing in the same was combined with other bases. It will be, no doubt, also remembered that I found that the mean quantity of acid phosphate of magnesia, $2MgO$,

* Abstract of a paper read before the British Association, Exeter meeting, Section A.

† Read before the British Association, Exeter meeting, Section B.

HO,PO_5, in ten samples of cotton fibre which had been imported from various parts of the globe, was equal to 0·05 per cent PO_5, or 0·084 $2MgO,HO,PO_5$.

But, before examining the nature and amount of phosphates present in the husk and seeds constituting the cotton pod, I deemed it advisable to repeat my former experiments, and to confirm them by separating the cotton fibre from the same pods from which I intended to submit the husks and seeds to analysis, and I am glad to say that I obtained results confirming entirely the previous ones, viz., that 100 parts of cotton fibre yielded, when repeatedly washed with water, a quantity of acid phosphate of magnesia = 0·084 of acid phosphate of magnesia, or 0·050 of phosphoric acid, and, further, as in my previous results, only a trace of potash and lime were found in solution, and that no other salts of magnesia existed in solution.

Husks.

To ascertain if the amount and nature of the phosphates in the husks of the cotton pods were the same as in the fibre, 14·45 grms. of husks were reduced to fine powder, and steeped for twelve hours with 250 grms. of distilled water. This operation was repeated four times each, and the whole of the washings were filtered off, evaporated to dryness, and the residue calcined, and the following results were obtained on the analysis of the ash:—Only a small quantity of magnesia and lime was detected, nearly the whole of the phosphoric acid being combined with potash and with oxide of iron. The following results being obtained—

One hundred parts of husk gave—

Phosphate of potash, 0·531 = 0·178 PO_5, combined with potash.
Phosphate of iron, 0·227 = 0·106 PO_5, combined with sesquioxide of iron.
Phosphate of lime, 0·030 = 0·016 only PO_5, combined with lime.
And a trace of magnesia.

Therefore the phosphoric acid in the husk is not combined with magnesia, as in the fibre, but with potash and oxide of iron, and the total amount of phosphoric acid, instead of being 0 050, as in the cotton fibre, is 0·300, or six times as large.

Seed.

I now proceeded to determine the composition and amount of phosphates in this portion of the cotton pod, and obtained the following results:—

0·650 of phosphate of potash.. = PO_5, 0·217
0·117 of phosphate of magnesia = PO_5, 0·069
0·025 of phosphate of iron..... = PO_5, 0·011

These results, which are the mean of two analyses, as in the previous cases, show that the phosphates exist in much larger quantity in the seed than in the other parts of the pod—being, in fact, about sixteen times as large as in the fibre, and between three and four times that found in the husk.

Thus the quantity of phosphoric acid and phosphate existing in the various parts of the cotton pod are—

	PO_5.
Husk	0·300
Fibre	0 050
Seeds	1·092

The above results reveal two important facts—viz., that phosphate of potash, magnesia, and iron predominate in seeds, and not the phosphate of lime, as it was generally admitted; also that the nature and amount of the phosphates vary with each part of the said pod.

Further, it will be observed, that, in the husk, the phosphates of iron and potash predominate; in the fibre, phosphates of magnesia; and in the seed, phosphates of potash and magnesia. And what increases the interest is that nearly the whole of the bases existing in the cotton pod are combined with phosphoric acid.

The Amount of Soluble and Insoluble Phosphates in Wheat Seed.

English White Soft Wheat.—220·8 grms. of very carefully picked and cleaned white wheat, dried at 230° F., were repeatedly washed with distilled water, and the washings evaporated, and the residue calcined, when only—

0·010 of residue was left, thus showing that water had little or no action upon the grain when acted upon in such a condition.

I therefore decided to act on the same grain when crushed, so that water could penetrate into the mass, and dissolve all soluble salts; but, before doing so, I deemed it advisable to determine the total amount of phosphoric acid existing in the wheat operated upon, and obtained, in one analysis, 0·633 per cent of phosphoric acid, and, in a second analysis, 0·677 per cent, or 55·5 on 100 parts of ash.

These results clearly show, as Fresenius has done before me, that nearly the total of the ashes left by wheat is represented by phosphates.

With a view of ascertaining what amount of these phosphates would be dissolved by water in crushed wheat, 50 grms. of white, crushed soft wheat, dried at 230° F., were placed in a bottle with 150 grms. of distilled water, mixed with a little carbolic acid, so as to prevent any fermentation, or the production of any acid. After twenty-four hours, the aqueous solution was removed, and a fresh quantity of distilled water added; and these washings were repeated until all mineral matter was dissolved, the whole of the washings were evaporated, and the residue calcined. The amount of phosphoric acid determined was equal to 0·394; therefore nearly two-thirds of the phosphoric acid or phosphates existing in wheat are soluble in water.

English Red or Hard Wheat.—I deemed it advisable to determine the total amount of phosphates and of soluble phosphates in red or hard wheat, as I had done in soft or white wheat, and thus found that 100 parts of red hard wheat, dried at 230° F., yielded 0·749 phosphoric acid; and that 100 parts of the same, when dried at 230° F., and crushed, yielded 0·376 of soluble phosphates.

I regret that I had not the opportunity of repeating these results on white and hard wheats obtained from various countries, or cultivated on different classes of soils, viz., clay, lime, or sand formations, as the phosphates are in larger proportion in red wheat than in soft, and that half the phosphates are soluble in the red wheat and two-thirds in the white soft wheat, and therefore I cannot, under these circumstances, assume that the difference in amount of the phosphates is due to the nature of the wheat, and not to the soil.

These results led me to inquire if the various parts which constitute the grain of wheat contain the same amount and nature of phosphates when separated by the successive and different operations carried out by a miller.

The results of my experiments, as it will be seen, have fully answered my expectations—viz., the phosphates in each section of the cortical parts of the grain do not so much vary in their nature as they do in quantity: their amount decreases gradually from the outer sections towards the central ones; thus, whilst

the flour contains only a trace of phosphates, especially soluble ones, the bran contains a large quantity.

The total amount of phosphoric acid in—

Bran.....1·682
Flour.....0·971

Soluble phosphates—

Bran.....1·264
Flour.....0·080

A large miller in the neighbourhood of this city having kindly consented to grind and bolt a few sacks of wheat, to enable me to obtain in a separated state the various parts constituting the grain, and placed in my hands the five distinct specimens, as representing in a rough way those various layers presented by a grain of wheat.

No. 1. Coarse bran.
No. 2. Coarse bran.
No. 3. Coarse sharps.
No. 4. Fine sharps.
No. 5. Flour.

Amount of Phosphoric Acid and Phosphates in the Various Parts of Wheat.

	Corn and bran.	II.	III.	IV.	Flour.
Phosphoric acid combined with sesquioxide of iron	0·042	0·047	0·037	0·015	0·022
Phosphoric acid combined with magnesia and a small quantity of CaO	1·485	1·259	0·657	0·329	0·047
					0·144
Phosphoric acid combined with potash	1·071	1·046	0·459	0·280	0·758
Total—	2·598	2·352	1·153	0·624	0·971
Phosphate soluble in water.	1·942	1·666	0·918	0·529	0·080

These facts also tend to show that most of the phosphates contained in wheat are not combined with the organic matter, but are in a free condition.

Further, that the greatest part of the phosphates are soluble, and combined with potash and magnesia, whilst the insoluble phosphates are represented by lime, iron, with a small proportion of MgO, the latter salt being probably neutral phosphate of magnesia, $3MgO,PO_5$, whilst the salt of MgO in solution is $2MgO,HO,PO_5$; and what tends to support this view is that, although the same weights of bran were washed with the same quantities of water, and for the same space of time, the quantities of phosphates of magnesia decrease rapidly in each successive layer of the seed as we proceed from its external part towards its interior.

Also that, whilst in No. 1 bran only one-fifth of the phosphates are retained as insoluble, in No. 4 one-sixth remains in an insoluble condition.

These analyses clearly illustrate that, although habit and pride have gradually led us to prefer white bread to brown, or more so bread made with nearly the whole of the constituents of wheat grain, still this practice is an error when we consider the nutritious properties of wheat, especially as a food for children, when phosphates are so essential to the formation of bone and blood; and medical men would confer a great boon on society if they were to impress the importance of feeding children with a wheaten preparation in which all the constituents of the grain were preserved.

These views are further supported by some very interesting researches published in the *Comptes Rendus* by M. Mège Morries, in which he proved that there was, in the inner cortical parts of the wheat, a special ferment, which converted most rapidly starch into sugar, and thereby facilitated the conversion of wheaten flour into bread.

These observations of M. Morries led him to devise a peculiar mode of grinding wheat, and making bread from the flour thus obtained, and the results were such that, from every hundredweight of wheat, he was enabled to obtain of bread—

Wheat, 100.
Ordinary process.....70 flour.....92 bread
M. Morries.....82 " .....110 "

This method was so satisfactorily carried out that the Emperor of the French adopted it at the military bakery of Paris, in which bread is baked every day for 100,000 men.

In conclusion, I may be permitted to state that I am aware of the analyses of wheat which have been made by Professor Way and Dr. Voelcker, and especially of those remarkable and extensive researches published by G. B. Lawes, F.R.S., and G. H. Gilbert, F.R.S., "On the Composition of the Ash of Wheat Grain," and, by the last-named gentleman, "On Wheat Grain and its Product in the Mill." But the researches of these gentlemen only give the total amount of phosphoric acid in these products, but do not give, as I have attempted to do, the respective various proportions of phosphates of potash, magnesia, lime, and iron which exist in the various parts of wheat grain.

ON THE PHOSPHORESCENCE OF THE SEA,

AND ON

OZONE IN CONNECTION WITH ATMOSPHERIC CONDITIONS.*

BY J. MOFFAT, M.D., F.R.A.S., F.G.S., &c.

As it appears from results deduced from observations taken at sea, that ozone periods (as on land) commence, and that ozone is in maximum quantity with decreasing readings of the barometer and the conditions of the south or equatorial current of the atmosphere, and that ozone periods terminate with increasing readings of the barometer and the setting in of the polar current, and that phosphorus is luminous and non-luminous under similar conditions, I supposed that there might be some connection between ozone and the phosphorescence of the sea.

Observations are still taken, and I hope to be able to give results from a larger area. The following are deduced from observations taken between latitudes 58° and 79° N., and longitude 6° E. and 67° W.:—

Table I.

Shewing the Amount of Ozone with (at Sea)—

Barometer.		Directions of the Wind.				Phosphorescence.	
Increasing.	Decreasing.	N. to E.	E. S. E.	S. to W.	N.W.	None.	Brilliant.
2·9	4·7	1·6	2·7	3·7	3·2	2·4	3·0

* Read before the British Association, Exeter meeting, Section B.

Table II.

Shewing the Mean Reading of the Barometer, Mean Temperature, and Daily Mean of Ozone at the Commencement and Termination of Phosphorescence of the Sea, between latitudes 58° and 79° N., and longitudes 6° E. and 67° W.

Phosphorescence.	Barometer.	Thermometer.	Ozone.
Commencement of	29·46	34·8	2·9
Termination of	29·65	30·0	1·5

Table III.

Shewing the Mean of the Barometer and Thermometer, and the Daily Mean of Ozone, with Commencement and Termination of Periods of Luminosity of Phosphorus, deduced from the Observations of Six Years (on Land).

Periods of Luminosity of Phosphorus.	Mean of Barometer.	Mean of Thermometer.	Mean of Ozone.
Commencement	29·640	47·3	5·0
Termination	29·734	43·4	3·0

By these results, it appears that the phosphorescence of the sea and luminosity of phosphorus occur under similar atmospheric conditions.

The amount of ozone the day before phosphorescence		0·8
" "	day of	2·5
" "	day after	1·9

Of auroral displays, one was without ozone, and 50 per cent were accompanied by phosphorescence.

A FEW REMARKS ON THE

REDUCED OR PRECIPITATED PHOSPHATE OCCURRING IN SUPERPHOSPHATES.

BY ALFRED SIBSON, F.C.S.

The fact of superphosphate "going back," or losing in soluble phosphate, on keeping, will hardly at present be disputed, the question at issue being whether the phosphate so reduced can be estimated or not.

It often happens that a quantity of superphosphate, which, when freshly made, contains, say, 25 per cent of soluble phosphate, is found, after keeping (in some cases only a short time), to have lost 2, 3, 5, or even more, per cent of its soluble phosphate; in fact, the paper of Mr. Sutton, which appeared two or three weeks since, and which, although averse to the above question, the superphosphate operated on is stated to have contained, originally, 23 per cent, while it then had only 17 to 18 per cent, or a loss of 5½ per cent. Instances of this kind are, however, familiar to all who have had much to do with this class of manures.

As it is, also, found impossible by the manufacturer to calculate upon the extent of this retrogression, it is a constant source of dispute between buyer and seller, and also tends to bring discredit on analysis, as there is no apparent reason why a superphosphate should contain less soluble phosphate at one time than it did at an earlier period; in fact, the contrary would naturally be expected from the concentration of the bulk through the loss of moisture.

There thus appears an urgent necessity for some means of determining the phosphate so reduced; and if a scientifically accurate method be not forthcoming, it appears to me only reasonable to be satisfied, under the circumstances, with some method which, for all practical purposes, gives comparative and reliable results; such a method I have found to be the following:—

The point is to find some reagent which does not affect the undecomposed coprolite (that being the mineral now more especially considered). I soon found that dilute acids, including acetic, citric, and oxalic (this least so), were objectionable on this account, and was led to try oxalate of ammonia, which, as a perfectly neutral salt, would be altogether unlikely to decompose a perfectly mineralised substance like coprolite. As well known, the decomposition of a gelatinous phosphate of lime by oxalate of ammonia is a quantitative reaction, which takes place at once, the only necessity for boiling being to assist the subsequent filtration. Boiling for ten minutes at the most is sufficient to effect this object, while the oxalate does not, under these circumstances, attack the coprolite to any material extent. I am aware this statement is somewhat at variance with the results of other contributors which have lately appeared, but, as the process they state differs from that I have adopted, the different results may, perhaps, be accounted for. I have no intention, however, of entering into a controversy on this subject, but give the full particulars of the process, so that any one interested in the matter can try it for himself. I have since found that oxalate of ammonia had been suggested by others for this purpose, but was unaware of the fact when I selected it.

25 grains of Cambridge coprolite are boiled, with an equal weight of oxalate of ammonia, in 2 ounces of water, for ten minutes, and filtered; the filtrate acidified with hydrochloric acid, and made alkaline with ammonia (merely to insure the presence of chloride of ammonium; and ammoniacal sulphate of magnesia added. No precipitate will probably be obtained; but, *if it be obtained*, it is not conclusive of the presence of phosphoric acid; and great errors may be made if a precipitate in this place be accepted as phosphate of magnesia and ammonia. After standing for two hours, the small precipitate is collected (which often resembles the phosphate closely, but consists of oxalate of magnesia, which sometimes separates from a concentrated solution, and a little oxide of iron) and re-dissolved in hydrochloric acid, citric acid added, and re-precipitated with ammonia. A precipitate, if now obtained, consists of phosphate of magnesia and ammonia only, and if burned and weighed as phosphate of magnesia in the usual way, will be found to amount to less than 0·50 per cent, calculated as bone-earth. This was found to be the case with coprolite ground as fine as it is possible to get it for analysis; but I have just been through the process again with coprolite in the state usually employed by manufacturers, and find no weighable quantity of phosphate of magnesia after standing three hours. I thus consider that 0·50 per cent of phosphate of lime is the utmost error that can be made by this process under proper management.

In the case of a superphosphate containing reduced phosphate, and treated as above, after having first extracted the soluble phosphate, by cold water, the phosphate of magnesia calculated as bone-earth will represent the phosphate so reduced.

I am aware of the new process, suggested by Mr. Chesshire, and adopted by the chemists for the plaintiff (with the exception of myself) in the late trial at Gloucester, referred to by that gentleman, and have, therefore, every confidence in its value, but have not yet satisfied myself whether it is superior to the plan I have hitherto adopted as above described.

I need scarcely add that it is not my intention to introduce the determination of the precipitated phosphate

into my ordinary analysis of superphosphate, nor include it in the usual determination of soluble phosphates, but only give it when especially requested, and state it separately; since, whatever its agricultural value may be (space forbids my entering upon this part of the question), it is no longer soluble phosphate, and will not obviously pass as such when a definite percentage of soluble is bargained for; its value is, however, at the same time very superior, I consider, to undecomposed, or ordinary insoluble phosphates.

There is one objection to the introduction of this constituent into the ordinary analysis of manures—viz. that it would be likely to lead to greater discrepancies than occur at present, and which, I believe, are caused far more by a want of sufficient attention and method in the details of the analysis on the part of the operator than by any defects in the method of analysis.

Finally, as regards the ordinary determination of soluble phosphates in superphosphates, I find the method of precipitation perfectly satisfactory and consistent when carefully performed, and believe it to be by far the best method; while, in point of time, it leaves nothing to be desired under proper management. I gave much attention to the uranium process some time since, but did not find it satisfactory in the case of superphosphates made from a mixture of phosphates.

ON

SOME DERIVATIVES OF TRICHLORMETHYL-SULPHON-CHLORIDE.

BY O. LOEW,

ASSISTANT IN THE CHEMICAL DEPARTMENT OF THE COLLEGE OF THE CITY OF NEW YORK.

This chloride, discovered by Berzelius and Marcet in 1812, was the subject of extended investigations by Kolbe. Since that time, no investigations on this compound have been made, although it possesses many interesting properties. I find that the simplest way to prepare it is the following:—300 grms. of bichromate of potassium, in pieces the size of a pea, 500 grms. of common hydrochloric acid, 200 grms. of nitric acid of the common strength, and 30 grms. of bisulphide of carbon, are mixed in a flask, filling it to one-fourth of its capacity, and loosely stoppered. It is kept cool in the beginning, and shaken from time to time. In about eight days the process is finished; in direct sunlight, only four days are required. By addition of water, the chloride and nitrate of potassium are dissolved, and there remains the insoluble trichlormethyl-sulphon-chloride. It is filtered off, washed, and pressed between sheets of filter paper.

When this chloride is dissolved in absolute alcohol, and treated with sulphuretted hydrogen, sulphur is deposited, and hydrochloric acid and another compound of an acid character remain in solution. By neutralisation with dry carbonate of sodium, the sodium-salt of this new acid remains dissolved in the alcohol, and crystallises by evaporation in shining scales.

0·469 grm. yielded 0·146 grm. of sulphate of sodium = 11·33 per cent Na.
0·236 grm. yielded 0·490 grm. AgCl = 51·37 per cent Cl.
0·511 grm. yielded 0·605 grm. of sulphate of barium = 16·24 per cent S.

The sodium-salt of the trichlormethyl-sulphurous acid requires—11·14 per cent Na; 51·95 per cent Cl; 15·56 per cent S; 15·56 per cent O; 5·81 per cent C.

To obtain the free trichlormethyl-sulphurous acid, the sodium-salt is decomposed by dilute hydrochloric acid and agitated with ether. The ether yields, by evaporation, this new acid in radiating needles. Both the acid and its salts are not of great stability; at a moderate temperature, especially when water is present, decomposition takes place, and a very offensive odour is evolved.

The formation of this acid takes place according to the following equation:—

$$\underbrace{(CCl_3)SO_2Cl}_{\text{Trichlormethyl-sulphon-chloride.}}{}^{*} + H_2S = \underbrace{(CCl_3)SOOH}_{\text{Trichlormethyl-sulphurous acid.}} + HCl + S.$$

The decomposition of this acid and its salts, by bromine and nitric acid, is very striking; the acid disappears, and new insoluble compounds are formed.

The action of bromine is expressed by the following equation:—

$$\underbrace{(CCl_3)SOOH}_{\text{Trichlormethyl-sulphurous acid.}} + Br_2 = \underbrace{(CCl_3)SO_2Br}_{\text{Trichlormethyl-sulphon-bromide.}} + HBr.$$

And the action of nitric acid—

$$\underbrace{(CCl_3)SOOH}_{\text{Trichlormethyl-sulphurous acid.}} + \underbrace{NO_3H}_{\text{Nitric acid.}} = \underbrace{(CCl_3)SO_2(NO_2)}_{\text{Trichlormethyl-sulphon-nitride.}} + H_2O.$$

The trichlormethyl-sulphon-bromide is a white crystalline body of a faint acrid smell, insoluble in water but soluble in alcohol and ether. On the application of heat a part is sublimed without change, while another part is decomposed. Ammonia dissolves it with evolution of nitrogen.

0·358 grm. yielded 0·313 sulphate of barium, corresponding to 12·01 per cent S.
0·492 grm. yielded 1·158 grms. AgCl + AgBr, and this mixture yielded, by reduction, 0·808 Ag, which proportions correspond to 30·77 per cent Br, and 40·22 per cent Cl.

The theory demands 12·19 per cent S, 40·57 per cent Cl, 30·48 per cent Br.

When trichlormethyl-sulphurous acid is brought into contact with concentrated nitric acid, a violent reaction takes place, and a blue oil is deposited which loses nitrous acid by contact with the air, and is converted into a white crystalline body, the odour of which inflames the eyes and is very suffocating when inhaled. This is the trichlormethyl-sulphon-nitride, especially interesting in this, that a nitride of an organic sulph-acid has been hitherto unknown. It is insoluble in water, soluble in ether and alcohol. Water added to the alcoholic solution precipitates it unchanged. It does not melt in boiling water, but is volatilised with the steam. Ammonia dissolves it slowly, with decomposition: alcoholic solution of caustic potassa decomposes it quickly. When it is treated with zinc and hydrochloric acid, it disappears, and is converted into sulphydrate of methyl and ammonia—

$$\underbrace{(CCl_3)SO_2(NO_2)}_{\text{Trichlormethyl-sulphon-nitride.}} + 18H = \underbrace{CH_3SH}_{\text{Sulphydrate of methyl.}} + H_4NCl + 2HCl + 4H_2O$$

0·5285 grm. yielded 0.532 sulphate of barium and 0·973 AgCl, corresponding to 13·83 per cent S and 46·12 per cent Cl.

* C=12 S=32 O=16,

Theory demands 14·00 per cent S and 46·61 per cent Cl.

On treating trichlormethyl-sulphon-chloride with ammonia, trichlormethyl-sulphurous acid is formed in an unexpected manner, nitrogen is evolved, and the chloride is slowly dissolved. On evaporation, broad tabular crystals are obtained. In the mother liquor, their remains chloride of ammonium, some sulphate of ammonium, and a certain quantity of this new compound. The crystals must be re-crystallised with great care, because, at a moderate temperature, an acid reaction sets in and a partial decomposition begins. These crystals show, with bromine, as well as with nitric acid, the formation of the above-mentioned bromide and nitride. The action of the nitric acid is extremely violent.

By mixing with diluted hydrochloric acid, and agitating with ether, the above-mentioned trichlormethyl-sulphurous acid is obtained.

0·431 grm. yielded 0·911 grm. AgCl=52·24 per cent Cl.

0·668 grm. yielded 0·725 ammonio-chloride of platinum =6·80 per cent N.

0·753 grm. yielded 0·894 grm. sulphate of barium=16·23 per cent S.

Theory demands 53·11 per cent Cl, 6·98 per cent N, 15·96 per cent S.

The crystals are, therefore, the ammonium salt of the trichlormethyl-sulphurous acid, and their formation can be expressed by the following equation:—

$$\underbrace{3[(CCl_3)SO_2Cl]}_{\text{Trichlormethyl-sulphon-chloride.}} + 8H_3N = \underbrace{3[(CCl_3)SO_2H_4N]}_{\text{Trichlormethyl-sulphite of ammonium.}} + 2N + 3H_4NCl$$

On treating trichlormethyl-sulphon-chloride with cyanide of potassium, evolution of cyanogen and hydrocyanic acid takes place, and the potassium salt of trichlormethyl-sulphurous acid is formed—

$$(CCl_3)SO_2Cl + 2KCy = (CCl_3)SOOK + KCl + 2Cy.$$

But, when the solution is hot and very concentrated, there is, also, another derivative of this acid formed, one atom of Cl being replaced by one atom of OH—

$$(CCl_3)SOOK + H_2O = (CCl_2OH)SOOK + HCl,$$

which latter decomposes another part of the cyanide of potassium.

A glance at the following formulæ will show the relation between these new bodies and several others already known:—

Trichlormethyl-sulphon-chloride $(CCl_3)SO_2Cl$ (Kolbe).
Trichlormethyl-sulphon-bromide $(CCl_3)SO_2Br$.
Trichlormethyl-sulphon-nitride $(CCl_3)SO_2(NO_2)$.
Trichlormethyl-sulphur*ic* acid $(CCl_3)SO_2OH$ (Kolbe).
Trichlormethyl-sulphur*ous* acid (CCl_3) SOOH.
Methylsulphur*ic* acid $(CH_3)SO_2OH$ (Kolbe).
Methyl-sulphur*ous* acid $(CH_3)SOOH$ (Hobson).

—*American Journal of Science.*

ARTIFICIAL PRODUCTION OF ICE.

BY. P. H. VANDER WEYDE, M.D.

Calculation of the Amount which can be Produced from a Given Amount of Coal in the Modern Ice Machine.

The amount of ice produced by an ice machine, worked by means of an exhaust or condensing air-pump, driven by steam power, is easily determined, theoretically, from the amount of coal burned in the furnace of the steam boiler. It has been proved that the combustion of one pound of anthracite coal produces, in round numbers, 14,000 units of heat, and that in order to freeze water of 72° Fahr., it is necessary to abstract, besides 40° of sensible heat, 140° of latent heat—together 180°—which, for one pound of water is, of course, equivalent to 180 units of heat. As this number of the units is the eightieth part of the 14,000 units produced by the combustion of one pound of coal, it is clear that the heat produced by the combustion of one ton of coal is equivalent to the heat to be abstracted from 80 tons of water of 72°, in order to change it into ice.

But in practice we find here exactly the same state of affairs as is the case with the steam engine. Theoretically, a steam engine ought to produce at least 700 units of force (foot-pounds) for every unit of heat consumed; in practice, good machinery only produces from about 70 to 100 foot-pounds, from about one-tenth to one-seventh part of the theoretical amount. In the best ice machines thus far constructed, instead of freezing 80 tons of water, for every ton of coal consumed, only from about 8 to 11 tons of ice are produced, also, from one-tenth to one-seventh part of the theoretical amount, proving, thus, the remarkable fact, that in both the steam engine and the ice machine, exactly the same relation exists between the theoretically calculated effects and the practical results.

As, however, all the best ice machines accomplish the conversion of the heat of the fuel into the freezing operation by the intervention of a steam engine, the fact that they practically produce only from one-tenth to one-seventh of the amount of the cold they theoretically should produce, is solely due to the other fact, that the steam engine itself practically produces only from one-tenth to one-seventh of the amount of power which would be strictly equivalent to the number of heat units consumed. It must not be lost sight of that it is only the power of the steam engine which generates the cold in the freezing machines, and that, therefore, improvements in the steam engine, which bring its practical results nearer to the theoretical standard, will at once exert their influence on the amount of ice the ice machines can produce, and, consequently, also on the cost of the ice manufactured in these machines.

Moreover, it appears that the kind of freezing machines in question, which convert power into cold, notwithstanding they are yet in their infancy, have already attained such a degree of excellence, that they are ahead of that class of machines which convert heat into power, either by steam, hot air, or any other possible means, as it is proved that they produce the full theoretical equivalent of cold (negative heat) for the number of foot-pounds employed; namely, cooling one pound of water one degree for a power equivalent to 700 pounds, descending one foot, which, expressed in the adopted scientific manner, is one unit of negative heat for every 700 foot-pounds consumed.—*Scientific American.*

ON A

NEW SOURCE OF THE FIRST TERMS OF THE FATTY ACIDS,

AMONGST OTHERS OF PROPIONIC ACID.

BY M. BARRE.

The dry distillation of wood produces a very acid liquid,

from which acetic acid is extracted in large quantities. The general mode of purifying the latter is to saturate the liquid with carbonate of soda, when concentration produces crystallised acetate of soda and mother liquors. These latter diffuse a strong smell of molasses. When a certain degree of concentration has been reached, the crystals cease to form, and, if evaporation be continued, they assume a confused and hygrometric mass. This latter has been the subject of my experiments. On treatment with sulphuric acid, it decomposed, forming two liquid films, which were mingled into one by the addition of water. Instead of separating these acids by fractional distillation, I operated upon their ethers, first separating them into volatile portions—

I.	Between	55°	and	58°.
II.	"	74°	"	77°.
III.	"	95°	"	98°.
IV.	"	114°	"	119°.
V.	"	133°	"	136°.
VI.	"	162°	"	165°.

and then saponifying with baryta.

I. The baryta salt produced by the ether boiling at 55° or 58°, being heated with monohydrated sulphuric acid, disengaged pure oxide of carbon. This salt reduced nitrate of silver at the boiling point; formed with perchloride of mercury a white precipitate of protochloride, &c.; and it presented the crystallographic characteristics of formiate of baryta. The ether produced was therefore nearly pure ethylformic ether.

II. The baryta salt No. 2 was acetate, as might be foreseen.

III. Baryta salt No. 3, after purification by successive crystallisations, assumed the form of perfectly defined oblique prisms. The dry salt remained unaltered in the air. Its solution, left in contact with the atmosphere, evolved a slight odour, which proved the commencement of decomposition. When dried at 100°, it decomposed slowly, losing its water of crystallisation, and changed into a salt insoluble in water. It was impossible to obtain a sensibly-pure salt, except by evaporation at a very low temperature in a receiver whose atmosphere had been dried by sulphuric acid. Analysis gave 50·7 of baryta per cent of the salt. The propionate of baryta, according to the known formula, $C_6H_5BaO_4.HO$, contains 50·7 per cent of baryta.

The lead-salt, dried at 110°, yielded a syrupy, transparent, non-crystallisable mass.

IV. Baryta salt, No. 4, took the form of flattened prisms, melting below 100°. On analysis, it yielded 44·0 per cent of baryta; the butyrate of baryta, $C_8H_7BaO_4.2HO$, contains 44·6. This salt, when treated by chlorhydric acid and chloride of calcium, decomposes, and leaves a film of butyric acid floating on the surface of the liquid. Treated with a mixture of alcohol and sulphuric acid, it forms ethyl-butyric ether, having the characteristic smell of pineapple.

V. Ether, No. 5, treated like the preceding, gives a salt which crystallises in thin flakes which effloresce quickly on contact with the air. The dry crystals, finely powdered and thrown into water, perform rapid gyrations.

When again dissolved in water and treated with sulphuric acid, an acid is formed, insoluble in water, distilling between 172° and 178°; this is valerianic acid.

VI. Baryta salt, No. 6, was crystallisable, but with difficulty. Its solution, treated with sulphuric acid, sets free a liquid acid lighter than water, but slightly soluble in the cold, soluble when warmed, soluble in every proportion in alcohol, distilling at from 198° to 205°. When saturated by a standard solution of caustic baryta, its equivalent was found to be 118·1, whilst that of caproic acid is 116. The difference of the equivalent is owing to the presence of a small quantity of acid boiling at a higher temperature, which hinders the crystallisation of the caproate.

On examining the relative proportions of these acids, formic acid is found to occur in small quantities only. Acetic acid is most abundant, the relative proportion of each diminishing as it rises in the series.

Propionic acid, whose soda-salt is very soluble in water, is found thus concentrated in the preparation of acetate of soda. The mother liquors, which contain a large quantity, might become an abundant source of its production, which has hitherto been attended with difficulty. The transformation of soda-salt into ethylic ether allows of complete purification.

This series of homologous bodies produced by a single reaction is dependent upon a general law in organic chemistry, that of simultaneous production; either in the order of analysis, the homologous bodies being produced by successive divisions, or in the order of synthesis, being formed inversely by successive additions. —*Comptes Rendus*, vol. lxviii., p. 1222.

ON A NEW REACTION OF PHENOL.

BY C. CRUMP.

If fragments of caustic potash be added to a solution of phenol in chloroform, the potash becomes covered with a rose-coloured coat, which gradually dissolves in the liquid. Considerable heat is produced, and the action goes on rapidly until the mixture which at first was red has become brown and thick. It then slackens, but may be renewed by a gentle heat, until potash has been added equal in quantity to about three times the weight of the phenol.

The final product of the reaction is a brown amorphous mass, soluble in alkaline liquids, and precipitated therefrom by acids. It seems to be a mixture of two substances, differing in solubility in alkalies and in their behaviour with strong sulphuric acid.

The first substance dissolves very easily in carbonate of potash or soda, less readily in strong sulphuric acid. From the latter solution a precipitate is thrown down by water, which behaves with alkalies like rosolic acid.

The second substance dissolves less freely in alkalies, very easily in strong sulphuric acid, forming a brown liquid from which nothing is precipitated on dilution. With tetrachloride of carbon instead of chloroform no action takes place in the cold; at 100° C. the liquid assumes the colour of rosolic acid.

When creosote from wood-tar is treated with chloroform and caustic potash, a reaction takes place very similar to that with phenol, but the product of the reaction is quite different, forming with sulphuric acid a deep crimson solution, from which a dingy green precipitate is thrown down by dilution. Moreover, the substances produced from phenol in alkaline solution colour silk or wool brown, while those from creosote have no colouring power.

ON SPIRIT MADE FROM RICE.

BY JAMES BELL, ESQ.

There has always been a difficulty experienced in

producing from rice a spirit free from a pungent odour. An impression prevailed that the pungency was due to the presence of some compound ether generated during the process of fermentation; but how or why it was produced in the fermentation of a saccharine extract prepared from rice, and not in that obtained in the ordinary way from other materials, was a problem which appeared difficult of solution.

In the course of manufacture of spirit from rice, sulphuric acid is the agent employed for converting the starch of the rice into glucose, and this process is conducted in a close wooden vessel under steam pressure at a temperature ranging from 216° to 230° Fahr. It has been observed that when the process of saccharisation was conducted at a temperature approaching 230°, the spirit obtained was more pungent than if the lower temperature had been observed. It has also been remarked that the pungency of the spirit was less in proportion as the rice was purified or freed from the husk.

Being desirous to investigate this subject, I undertook the examination of a sample of rice spirit which was placed at my disposal, and which had been made from rice that had been only partially freed from the husk, and though it appeared that the temperature during the process of saccharisation was maintained at about 216° Fahr., the spirit was very pungent.

The spirit was found, on the application of a slight heat, to freely reduce ammoniacal nitrate of silver, but without depositing the metal in a specular form; and a very small quantity sufficed to instantly decompose a solution of a permanganate.

When a portion of the spirit was treated in the cold with caustic potash and allowed to stand for a few hours, the pungency rapidly disappeared, and there was simultaneously produced a dark brown resinous substance soluble in alcohol and ether. The spirit recovered by distillation from the alcoholic alkaline solution was free from acrid odour, and gave the normal reaction with the mercury compounds for ethylic alcohol.

The addition of a very small quantity of the acid sulphite of sodium to the spirit, rapidly destroyed the pungent odour, and the alcohol obtained afterwards by distillation was unobjectionable in quality.

These reactions, it will be seen, pointed directly to the presence of an aldehyde, and in order to identify it, a portion of the spirit was introduced into a stoppered bottle, and treated in the cold with moist oxide of silver and left in contact therewith for several days. At the end of this time, there was a slight deposit of the metal on the glass, as well as other evidence that a quantity of the oxide had been reduced. To obtain the oxidised product, the excess of oxide of silver was removed by filtration and the silver salt in solution exactly decomposed with hydrochloric acid. The precipitate of chloride of silver was then filtered off, and the liberated acid neutralised with baryta and the spirit distilled. The distillate obtained was destitute of pungent odour, and the spirit was commercially pure.

The baryta salt which formed the residue in the retort was decomposed with sulphuric acid, and the liberated organic acid separated from the insoluble sulphate by distillation. The acid thus obtained proved to be acrylic, which had been produced from acrylic aldehyde by oxidation, and consequently, it was to the presence of this aldehyde that the pungent odour of the spirit was due.

There can hardly be a doubt that it is during the process of saccharisation that the fatty substances contained in the rice are decomposed; and that the acrolein is immediately thereupon produced by the action of the sulphuric acid upon the glycerine; and this view would seem to be borne out by the fact stated above, that a variation in the steam pressure in conducting the process of saccharisation affected the quantity of the acrolein produced.

It is well known that fats in a state of emulsion are in a condition to be readily acted upon by chemical reagents and to be decomposed, and it is not improbable that the conditions in this case are favourable to the action of the sulphuric acid upon the fatty substances in the rice, and in effecting their decomposition.

A sample of the rice from which the spirit was prepared was found to contain 0·62 per cent of fats, and assuming that the whole of the glycerine contained therein was converted into acrylic aldehyde, and that 65 per cent of starch was actually utilised in the production of ethylic alcohol, every thousand grains of the latter would contain one grain and a-half of the aldehyde.

The fact has long been known that rice spirit contained some compound which possessed the property, like acetone, of dissolving and keeping in solution certain compounds of mercury which are insoluble in pure alcohol and in water; and that before the absence of wood naphtha in rice spirit could be established by the ordinary chemical tests, it was necessary to distil the spirit once or twice from caustic potash.

The sample of rice spirit in question possessed the property of preventing the precipitation of the mercury compounds in an eminent degree, but the spirit after the complete separation of the acrylic aldehyde gave the normal reaction for pure alcohol.

To test the solvent power of acrolein for the mercury compounds, a small quantity of the aldehyde was prepared, and it was found to possess the property of preventing the precipitation of the ammonium compound of iodide of mercury in an alkaline solution, to nearly the same extent as acetone; and a very minute quantity of it was sufficient to impart a pungent odour to pure alcohol, similar to that possessed by the rice spirit.

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.[1]

The object of the present series of articles is to place my own practice before beginners in microscopical science; for although there are a vast number of existing works on the microscope, many of them are of a popular nature and addressed to those who seek in the microscope a means of recreation rather than of scientific research. My wish is to supply simple and practical directions to aid the student, giving very much in detail such processes as are but little mentioned in books, and which are more usually learned by seeing the instrument in the hands of an experienced person; but as this is an advantage not accessible to every one, it would seem that there is still a want, which it is my hope that this and succeeding papers will help to supply, and prepare the student to consult with profit more elaborate treatises.

I have thought proper, therefore, to devote this

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1862.

article to the consideration of the instrument we have to work with. No workman is any the worse for a knowledge of the contents of his tool-chest; in fact, he will be far better qualified for making use of the appliances he possesses by knowing their construction.

Microscopes vary much in their details of construction, each maker having an instrument for which he claims its own especial merit. For convenience sake, the general plan of structure may be described as consisting of a tube containing the optical portion, capable of a sufficient range of motion to and from a support for the object to be examined, known as the stage, beneath which is placed a mirror, provided with the necessary adjustments for reflecting light upwards through the aperture in the stage.

The plans employed for supporting the tube containing the lenses, or "body," are two in number; in one, that adopted by Messrs. Beck and a few other makers, the body is supported by the greater part of its length, and runs in groove of peculiar form, which effectually prevents the detrimental movement known as "twist." In the other mode, the one used by Messrs. Ross, Powell and Leland, and the majority of opticians, the body is attached to the extremity of the cross-arm, the rack work moving up and down in a tube attached to the trunnions which carry the instrument between the two uprights connected with its base. This last plan of construction involves the use of a greater weight of metal and a more careful disposition of it to secure stability than where the body is supported in the former manner, but when skilfully made there is no practical objection to its employment.

Dr. Carpenter speaks highly of the first mode, which is also approved of by Dr. Bowerbank: my experience is decidedly in its favour, my own instrument so constructed having been exposed to more than ten years' severe wear, and having had no substantial repairs during that period.

The part of the microscope I wish to direct attention to in the first instance, is the body and its contents. A combination of lenses called the object glass is screwed to the bottom of the tube, and another called the eye-piece, is placed at the top. For the sake of simplicity, the binocular arrangement will be for the present omitted, the instrument being supposed to have but a single body. In order that the use of the glasses contained in this tube may be understood, I must direct attention in the first place to some of the properties of light.

A *ray* of light, which is a very arbitrary term, may be considered, for the present purpose, as a small cylinder of light—a thing which has no real existence in nature, but will serve well for the purpose of demonstration. It is very much what the line is in mathematics.

Should this ray of light fall upon a polished surface which is not capable of allowing it to go through, or, in other words, an opaque polished surface like a bright plate of metal, *c*, *d* (Fig. 1), if the ray of light, *b*, *a*, falls upon that surface perpendicularly, it will be sent back by the same course through which it came down. On the contrary, should the ray of light *e*, *a*, fall obliquely, it will be reflected at an angle, *b*, *a*, *f*, equal to that *e*, *a*, *b*, at which it fell upon the reflecting medium. This angle of incidence, *e*, *a*, *b*, will be equal to the angle of reflection, *b*, *a*, *f*. Now this principle is made use of in our commonest means of illumination,—the mirror under the stage by which the light from a lamp or other source of light at one side or in front of the microscope, or in any other convenient place, is directed through the axis of the instrument. In the subsequent papers I shall say more about the application of the reflective principle. This is the only instance to be noticed at present.

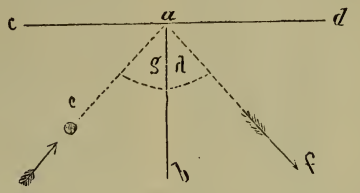

Fig. 1.

Now, supposing that the ray of light falls upon a transparent material (a plate of glass, for example, a substance more dense than air), should the ray, *c*, *d*, fall upon this plate of glass, *a*, *b* (Fig. 2), perpendicularly,

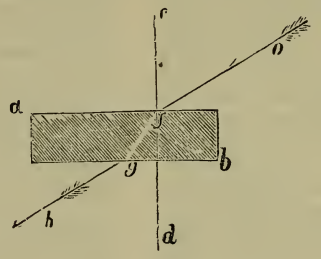

Fig. 2.

it passes it straight through without any alteration taking place; but should the ray of light, *e*, *f*, fall obliquely, it will no longer pass through in the same direction, but will be bent towards the perpendicular, *c*, *d*, in a greater or less degree according to the density of the medium, as at *f*, *g*, and is bent again upon its emergence into the rarer medium at *g*, towards *h*.

The amount of "refraction," as this bending is called, would be much less with water than it would be with glass, and it would be greatest of all in the diamond, other substances refracting in intermediate degrees.

The effect of refraction is familiarly illustrated by the well-known phenomenon of objects immersed in water appearing to be nearer the surface than they really are, a pool appearing to be only three or four feet deep, when in reality it is nearer six or eight. This may be readily demonstrated by placing a stick or other object in a basin of water (Fig. 3); the stick will

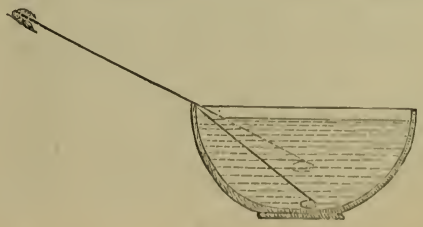

Fig. 3.

appear bent where it enters the water; a coin or other object will appear to be at a much less depth than it actually is.

It is owing to refraction that we are able to make

[English Edition, Vol. XX., No. 513, pages 145, 146.]

use of lenses, which give us the power of bending rays of light and turning them about in any way that may be required.

Lenses are circular pieces of glass or other transparent material capable of refracting light, and having curved surfaces, either convex or concave.

The action of a lens upon a ray of light will be best understood by reference to Fig. 4. For the sake of

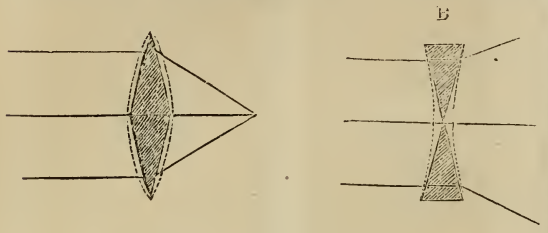

Fig. 4.

simplicity the dotted curved lines representing the section of the lenses may be considered as straight lines, as shown in the diagram.

It has been shown (Fig. 2) that when a ray falls obliquely it is refracted, but that when it falls at right angles with the refracting medium it suffers no refraction. The central ray in both A and B passes straight through without refraction; in A the inclination of the surfaces is such that the rays passing above and below the centre line converge at a point called the focus. The lens, B, being thickest at the margin, the effect is just the reverse; the rays are dispersed, and do not come to a focus but diverge, as if they proceeded from a point on the opposite side of the lens, called the virtual focus. These concave lenses do not magnify, but are used in microscopes and other optical instruments, for purposes to be hereafter mentioned: the most familiar instances to be cited of their use are as the eye-glass of an opera-glass or Galilean telescope, and as spectacles for short-sighted persons.

Lenses may be made with one side worked to a plane surface and the other either convex or concave, such lenses are known as plano-convex and plano-concave lenses; their respective powers are about half those of lenses of similar and double curvatures. There are also lenses convex on one surface, and concave on the other; these are called meniscus lenses; the curves may be so proportioned that they have either the power of convex or concave lenses, according as they are thickest in the middle or at the edge; they have, moreover, some properties peculiar to themselves which are turned to good account by skilful opticians.

The formation of images is one of the most valuable properties of convex lenses, and one taken advantage of in the construction of optical instruments. If a convex lens is held at the distance of its focal length in front of a sheet of paper or other white surface, an inverted picture more or less distinct will be seen of objects that may be before it, such as a window or candle flame. This is illustrated by the diagram Fig. 5, repre-

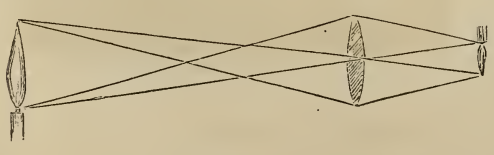

Fig. 5.

senting a candle flame on the left hand, from the apex of which two rays diverge, the lower one reaching the lower edge of the lens and the upper one its centre. Rays proceed from each point of the flame to every part of the surface of the lens, but, for the sake of clearness, only two are here represented. After passing through the lens they converge; the same takes place with the rays proceeding from the lower part of the flame, which also pass through the lens. The result is the formation of an inverted image, the size of which and its distance from the lens are dependent upon the distance of the object and the focal length of the lens.

The greater the distance of the object, or "anterior focus," the shorter will be the distance of the image, or "posterior focus." The commonest example may be taken from the operations of the photographer, who, if he wants to take a small portrait, will place the sitter at a great distance from the camera, if, on the contrary, he desires a large figure, he will bring his model nearer; in the former case the posterior focus of the camera will be shorter than in the latter, which is shown by the camera requiring to be lengthened when the model is brought near to it.

Besides the use of lenses to form images, they are also employed as magnifiers, and constitute the simplest form of microscope. Most naturalists and microscopists are provided with some little contrivance of this kind either attached to the watch chain or carried in the pocket,—either one or more lenses suitably mounted, or the Stanhope lens. In all these simple microscopes no image is formed, so that the principle upon which a magnified view is obtained is different. The idea of the magnitude of an object is formed entirely by the space which it occupies upon the retina of the eye. It is quite irrespective of its actual size; or, to express it in mathematical language, an object is large or small in proportion as it subtends a great or small angle with respect to the eye.

The eye has a certain power of adjusting itself to view objects at different distances, but there is a limit to the distance of distinct vision. It varies from five to ten inches in different persons. An object cannot be distinctly seen nearer than either one or other of these distances, or some intermediate point. Now optical science supplies a means of overcoming this difficulty. An object apparently enlarged by being brought nearer to the eye, becomes indistinct, because the pencils of rays proceeding from it diverge too much to be brought to a focus on the retina by the lens of the eye.

The optical instrument most closely resembling the eye is the camera obscura. When the rack is run out to its full extent and the body is drawn out as far as it will go, and the object is still too near to be focussed distinctly, the position is precisely that of the eye with an object too close to it for distinct vision.

The remedy with the camera, supposing that no more focussing space could be obtained, would be to shorten the focus of the lens; that is, use one of greater refractive power. The same thing must be done in the case of indistinct vision, by interposing a convex lens and so increasing the convergent power of the lens of the eye; the object, hitherto too near the eye, *a*, *b*, is thus rendered visible and clearly defined, but with this remarkable difference, that it appears not to be the image of the object placed near the eye, but of a larger object, A, B, at the distance of distinct vision. No crossing of the rays takes place, and consequently the image is not inverted.

The hand magnifier is an extremely useful instrument, but many persons find great trouble in using it

to advantage, especially when it is of short focus and high power. A trifling hint about its use may be of value.

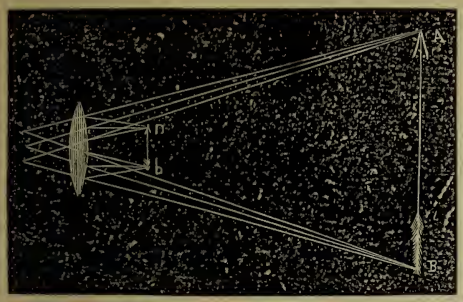

Fig. 6.

Hold the object in the left hand, either in the fingers or with forceps, and, placing the left hand against the right which is holding the lens, look through the magnifier and adjust the focus. The view is usually most distinct when the eye is in one focus of the lens and the object in the other; the two hands being held in contact move together and prevent that tremor which would be apparent, especially with high powers, if the hands were kept apart, and which unsteadiness prevents any accurate view of the object being obtained. Single lenses, when their diameter exceeds that of the pupil, possess the property of bringing light to the eye and rendering the object clearer than it would be without such assistance. This may be proved by looking at print or other suitable object in a bad light and noticing how much the magnifier aids by its light-collecting power.

Single lenses are mounted on stands of various kinds, and then they become what are called single or simple microscopes. The older observers had no other instruments. These may consist of many lenses, while the compound microscope may be made with as few as two; but then they act upon the principle that no image is formed, but the object is rendered visible at a shorter distance than it could be without optical aid. Single microscopes are still in use for dissection and other purposes where only a low power is required. And various contrivances have been adopted by which both eyes may be used and much fatigue saved in protracted operations.

The compound microscope differs from the simple instrument just mentioned in an image being formed and again magnified by being viewed with another lens or eye-piece (Fig. 7).

From what has been said before respecting the formation of images, it is evident if a lens of short focus is used and an object placed before it, the image will be formed at a great distance behind it and be much enlarged; if instead of viewing this image directly, as in the camera obscura, it is viewed with a suitable lens, another enlargement takes place. Such an instrument might be constructed with only two lenses, as in the diagram Fig. 7, A, but a microscope so made would of course be a very imperfect instrument; indeed it would in almost every point be inferior in its performance to that of a simple lens, principally because the eye lens magnifies all the imperfections of the image formed by the small lens or object-glass.

* Figs. 6, 7, 8, and 10 are taken from "The Microscope and its Revelations," by W. B. Carpenter, M.D. (Churchill).

These imperfections are chiefly caused by the spherical and chromatic aberrations of the object-glass, and also in some degree by those of the eye-piece.

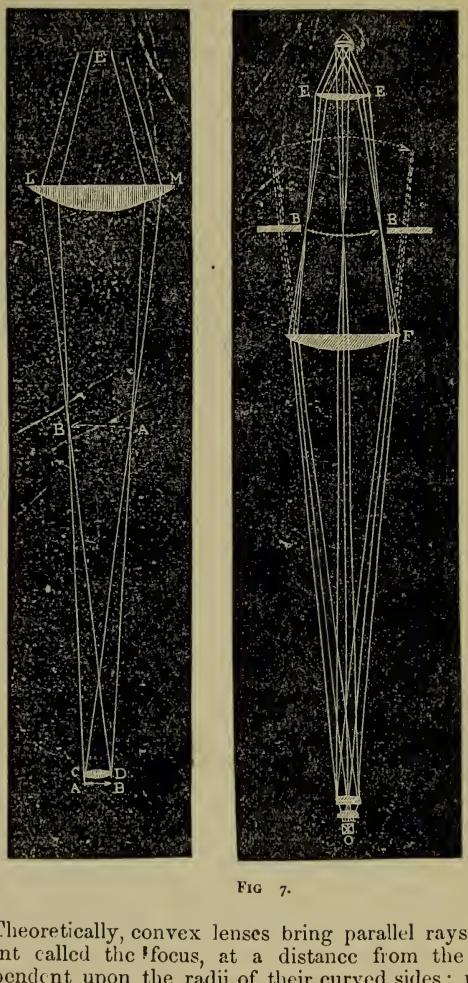

Fig 7.

Theoretically, convex lenses bring parallel rays to a point called the focus, at a distance from the lens dependent upon the radii of their curved sides; practically, this is not the case; the rays passing through the marginal portion of the lens come to a focus at a shorter distance from it than those which pass through or near its centre (Fig. 8). Those passing through in-

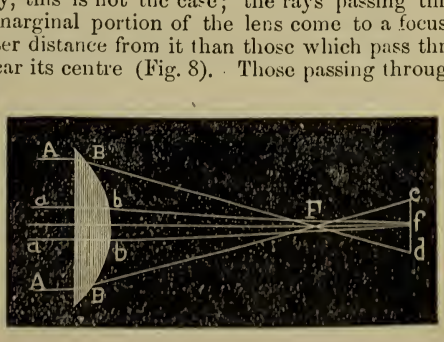

Fig. 8.

termediate portions converge to some part between these two points; the result is that indistinct images are formed at various points between F and *f*, Fig. 8, no well-defined figure being seen anywhere. Could

lenses be made having an hyperbolic or elliptic section, the spherical aberration would be corrected, but the difficulties of making lenses of such figures are so great as to be considered impossible in practice. Spherical aberration may be lessened by reducing the aperture of the lens, by cutting off the marginal portion by means of stops or diaphragms; but any great use of this means causes a loss of light very detrimental to the performance of the instrument. Advantage may also be taken of the position in which the lens is placed and also of its figure; the spherical aberration of some lenses, such as plano-convex and meniscus, is much affected by the way they are placed, being much greater in one position than another. Much may be done by placing the glasses in their most favourable position and using suitable curves: as a striking example, take to pieces a photographic lens and observe the curious forms adopted in its construction. The details of these corrections are rather a matter for the practical optician, and are unsuitable for an elementary treatise on the microscope.

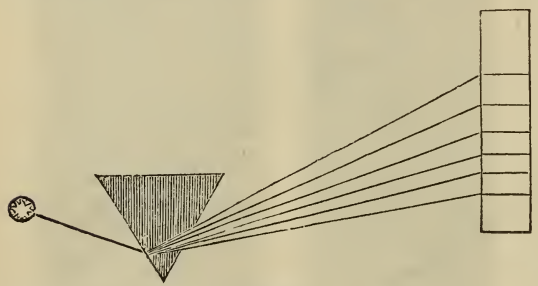

Fig. 9.*

Chromatic aberration is caused by the unequal refraction of the constituents of a ray of light. If a ray he bent by passing through a glass prism, instead of the ray appearing on the other side as white light, it will be decomposed, owing to the unequal capability of bending which the rays possess; the red ray is bent least, the yellow more, and the blue and violet most of all (Fig. 9). This also takes place when light is caused to pass through a lens (Fig. 10). The blue ray being

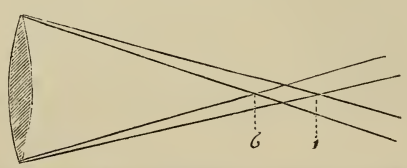

Fig. 10.

the most refrangible comes to a focus nearest to the lens at *b*; the red ray being the least refrangible will not converge until it reaches *r*; the yellow, green, etc., rays come to a focus at intermediate points, so that a series of images surrounded by fringes of their respective colours would be formed at various points between *b* and *r*, such coloured margins rendering the definition extremely defective. Chromatic aberration may be lessened by the use of stops, cutting off the marginal portion of the lens, but at the sacrifice of a great quantity of light and the impairing of some of the most valuable qualities of the glass for microscopic purposes. Fortunately, a means has been found of almost entirely correcting chromatic aberration. Different kinds of glass vary not only in their refractive power but also in the degree in which they disperse the coloured rays, and, by combining lenses of suitable forms and materials, the error of one lens is so neutralized by the opposite error of the other that the combination as a whole is nearly free from the production of colour, or becomes, as it is termed, achromatic. For the practical application of this valuable fact, we are indebted to the elder Dollond, who constructed telescopes on this principle towards the end of the last century. The object-glass of the microscope was not improved until many years afterwards.

Owing to the very divergent condition of the rays proceeding from a minute object placed near the lens of a microscope, the construction of an achromatic object-glass is much more complex than the combination employed in other optical instruments. High powers contain as many as three combinations of compound lenses placed behind each other, the careful adaptation of which requires the greatest skill on the part of the optician, and necessarily causes objectives of large aperture and great perfection to be very costly. A valuable series of papers by Mr. F. H. Wenham on the construction of object-glasses for microscopes will be found in the *Monthly Microscopical Journal*, vol. i. pp. iii., &c.

So perfectly was the correction of the chromatic and spherical aberrations effected, that it was found that even the covering of the object to be viewed with a thin plate of glass or mica rendered the image sensibly indistinct: fortunately the defect was no sooner discovered than the late Andrew Ross applied a simple remedy; some alteration was made in the disposition of the correcting media, and the front combination allowed a small range of motion backwards and forwards, which is usually regulated by a graduated collar, the use of which it will be well to explain, as, although it is to be found in most works on the microscope, it seems to be generally overlooked. Makers differ a little in the details of their arrangement for this correction, but there will always be found some mark indicating when the object-glass is corrected, for viewing an uncovered object. Focus carefully for distinct vision, with the glass so arranged, and then, taking hold of the collar, turn it round until a view is obtained of dust that may be resting on the upper surface of the cover of the slide; if the object is now focussed by the use of the fine adjustment, the correction for the thickness of the cover-glass will be found to be very perfectly made, and as the collar is usually graduated, the number may be noted on the slide for future use, as it is constant with the same object and eye-piece, and also for the same thickness of cover-glass.

The eye-piece usually employed in the microscope in combination with achromatic object-glasses is that invented by Huyghens, a Dutch astronomer (Fig. 7, B), and consists of two plano-covex lenses (E E and F F), with their plane sides towards the eye; this eye-piece, although not achromatic, when used with object-glasses slightly "over-corrected," renders the instrument achromatic as a whole. The optical principles involved are far too complicated to find a place in the present paper.

The power of the instrument may be greatly varied by using a series of eye-pieces of different power, and if the corrections of the object-glass are perfect, and its angular aperture sufficient to admit a large amount

* Hardwich's "Photographic Chemistry," p. 173 (Churchill).

of light, great advantage may be derived from the use of a short or "deep" eye-piece; but as the magnifying power of the eye-piece exaggerates every defect of the image, it is only with good object-glasses that this means of increasing the power is available. A very deep eye-piece is of value in testing the quality of an objective, as it causes defects which may not be apparent with lower powers to become very marked.

The power of the instrument is greatly influenced by the length of the tube or body, and were it not for the inconvenience of excessive length, this would probably be the least objectionable way of increasing the magnifying power, but a very long tube renders manipulation difficult, on account of its removing the hands to an uncomfortable distance from the stage and illuminating apparatus. Most microscopes have a sliding tube in the body known as the draw-tube, by which the length can be increased to the extent of four or six inches at pleasure.

(To be continued.)

PRELIMINARY NOTE ON A NEW CORNISH MINERAL.

BY PROFESSOR CHURCH, M.A.

During a recent visit to Cornwall, I purchased from Mr. Talling, of Lostwithiel, some specimens of a dark brown, amorphous mineral which had been recently found by him. These prove to be an unrecognised silicate of iron. Here are, in brief, the characters of the new species:—

Hardness, 2.75; specific gravity, 1·74. Amorphous, reniform, fissured, dark brown. Streak, pale rust-brown. Fragile; fracture, irregular conchoidal. Blowpipe—in closed tube, much water, having slight permanent acid reaction; on charcoal, decrepitates, and becomes black; partially fuses in outer flame to a black bead, in inner to a red-brown. Boiled in acids, leaves a siliceous skeleton.

This mineral gives, on analysis, the following percentages:—

Water	10·51
Silica	36·39
Ferric oxide	52·94
	99·85

The mineral also contains 0·82 per cent of P_2O_5, and traces of magnesia. It loses 29 per cent of water *in vacuo*, and only 0·54 per cent more at 100.° The analyses were made with the substance dried at 100° C.

The numbers above agree with the expression—

$$5Fe_2O_3,9SiO_2,8H_2O,$$

which demands 53·74 per cent Fe_2O_3, 36·58 per cent SiO_2, and 9·68 per cent H_2O; but many considerations point to the simpler formula, $Fe_2O_3, 2SiO_2, 2H_2O$, which demands—

	Theory.	Experiment.
$2H_2O$	11·39	10·51
$2SiO_2$	37·98	36·39
Fe_2O_3	50·63	52·94
	100·00	99·85

The chief discrepancy between theory and experiment concerns the iron, which is greater than it should be. This arises from three causes—(1) Traces of the iron exists as a ferrous salt in the mineral; (2) the percentage of Fe_2O_3 includes 0·82 per cent of P_2O_5; (3) it is difficult to separate the haematitic matrix from every portion of the mineral taken for analysis. The causes which have raised the iron percentage have also been amongst those which have reduced the silica and water percentages below their theoretical amounts.

The new mineral, which I shall name on a future occasion, has been mistaken for beraunite: it accompanies pyrite, chalybite, quartz, black haematite, and cronstedtite.

Royal Agricultural College, Cirencester,
September 18th, 1869.

ON THE SUPPOSED ACTION OF LIGHT ON COMBUSTION.*

BY CHARLES TOMLINSON, F.R.S., F.C.S.

The popular idea that "light puts out the fire," is so fixed, that probably no conclusions drawn from actual experiment are likely to disturb it, especially if they be adverse to the notion. It is a matter of daily experience, people say, that, if the fire is nearly out, and you put a screen before it, or draw down the blind, or close the window-shutters, it will immediately begin to revive. It is generally forgotten that a fire that looks dull, or "out," in a well lighted room, will appear to be in tolerable condition in the same room when darkened. only requires to be "put together" to make it burn up, and it might have been done so just as well in the light.

Experiments on this subject are not easy to make, on account of the many disturbing causes. In an old volume of the "Annals of Philosophy," is an account of some experiments by Dr. M'Keever, who took two portions of green wax taper, each weighing 10 grains, and ignited both at the same moment. One piece was placed in a dark room, at 67° F.; the other was exposed to broad sunshine, at 78° F.

In five minutes	The taper in sunshine lost	8½ grs.
	" darkened room lost.	9¼ "

The taper, divided into inches, was also burnt in the coloured portions of the solar spectrum, when it was found that the time required to burn two inches of taper varied as follows:—

	Mins.	Secs.
In the red ray it took	8	0
In the green	8	20
In the violet	8	39
In the verge of the violet	8	57

The conclusion is, that the solar rays, in proportion to their intensity, have the power of retarding, to a considerable extent, the process of combustion; and it is supposed that the chemical rays act, in some way, on the portion of oxygen about to combine with the fuel, so as to delay, if not prevent, combination.

Supposing, in these experiments, the taper was so uniform, that one inch contained precisely the same quantity of matter as another inch, the time occupied in burning was too short to justify so important a conclusion as Dr. M'Keever arrived at, whether the results were taken by measure or by weight.

Everyone engaged in photometrical observations must be aware of the difficulty of getting rid of disturbing causes and perplexing results. In comparing candles of the same make, the light is affected, both in quantity and economy, by a number of small circumstances, such as the warmth of the room, the existence of slight currents of air, the extent to which the wick

* Read before the British Association, Exeter Meeting, Section B.

curls over in burning, and so on. In testing the quality of gas, the standard candle defined by Act of Parliament is a sperm candle of six to the pound, burning at the rate of 120 grains per hour. From such a standard, we get the terms "twelve candle gas," "fourteen candle gas," &c. Mr. Sugg, in his "Gas Manipulation," has pointed out some of the difficulties in obtaining a uniform standard candle. The wick does not always contain the same number of strands; they are not all twisted to the same degree of hardness; the so-called sperm may vary in composition—one candle containing a little more wax than another, or variable quantities of stearine or of paraffin; the candle may have been kept in store a long or a short time; the temperature of the store-room may have varied considerably, and the temperature of the room in which it was burnt may have been high or low. All these circumstances affect the rate of combustion, and the illuminating power of candles, irrespective of the action of light, if such action really exist.

I have lately had a good opportunity of testing this action at the works of Price's Patent Candle Company, at Battersea. Under the direction of Mr. Hatcher, the accomplished chemist of the Company, the greatest possible care is taken to ensure identity of composition and illuminating power in candles of the same name. There has lately been an extensive series of experiments on the photometrical value of sperm candles, during which, at my request, Mr. Hatcher was good enough to note the rate of combustion of such candles in a darkened room, and also in broad daylight, and even in sunshine.

In the first observation, three hard and three soft candles were burned, each for four hours, in a dark closet. A similar set of candles, taken from one and the same filling, were burned, during the same time, in open daylight, partly in sunlight. The average consumption per hour of each candle was as follows:—

Sperm, in the dark		134 grs.
Ditto, in the light		141 "
No. 2 composites	In the dark	133 grs.
	In the light	140 "

It must be noticed that the temperature in the light was 72°, and in the dark 71°; moreover, in the light there was a much greater motion of the air than in the dark closet. Both these circumstances would operate in producing a larger consumption of candle.

In a second trial with No. 2 composites, the results were:—

In the dark	140 grs. each candle.
In the light	134 " "

In a third trial, also with No. 2 composites, the results were:—

In the dark	131
In the light	129

In these two trials, the flames were protected, as far as possible, from currents of air; and in a third trial, the temperature, both in the light and in the dark, was nearly equal.

The fourth trial was made on a bright, sunshiny day, with hard sperm candles, which are less affected by variations of temperature than the composites. The results were:—

In the dark (temperature, 81°), 544 grs., or 136 grs. per hour.
In the light (temperature, 84°), 567 grs., or 142 grs. per hour nearly.

It is evident that, in this case, the increase of temperature caused by the bright sunshine led to an increased consumption of material.

It will be seen that, in the first and fourth trials, there is a greater consumption of material in the light than in the dark; and in the second and third trials, the consumption is greater in the dark than in the light; but, in any case, the difference is so small—amounting only to from 2 to 7 grains per hour—that it may fairly be referred to accidental circumstances, such as difference in temperature, in currents of air, and in the composition and make of the candles; the final conclusion to which I am led being that the direct light of the sun, or the diffused light of the day, has no action on the rate of burning or in retarding the combustion of an ordinary candle.

SOME EXPERIMENTS

WITH THE

GREAT INDUCTION COIL AT THE ROYAL POLYTECHNIC.*

BY JOHN HENRY PEPPER, F.C.S., ASSOC. INST. C.E.

The Large Induction Coil.

The length of the coil from end to end is 9 feet 10 inches, and the diameter 2 feet; the whole is cased in ebonite; it stands on two strong pillars covered with ebonite, the feet of the pillars being of a diameter of 22 inches. The ebonite tubes, &c. are the largest ever constructed by the Silver Town Works.

The total weight of the great coil is 15 cwts., that of the ebonite alone being 477 lbs.

The primary wire is made of copper of the highest conductivity, and weighs 145 lbs.; the diameter of this wire is 0·0925 of an inch, and the length 3770 yards. The number of revolutions of the primary wire round the core of soft iron is 6000, its arrangement being 3, 6, and 12 strands.

The total resistance of the primary is 2·201400 British Association units, and the resistances of the primary conductors are respectively—For three strands, 0·733800 B.A.U.; six, 0·366945 B.A.U.; twelve, 0·1834725 B.A.U.

The primary core consists of extremely soft straight iron wires 5 feet in length, and each wire is 0·0625 of an inch in diameter. The diameter of the combined wires is 4 inches, and the weight of the core is 123 lbs.

The secondary wire is 150 miles in length; it is covered with silk throughout, and the average diameter is 0·015 of an inch.

The total weight of this wire is 606 lbs., and the resistance 33,560 B.A. units. The length of the secondary coil is 50 inches, and the insulation throughout is calculated to be 95 per cent beyond that required. The secondary wire is insulated from the primary by means of an ebonite tube of ½ an inch in thickness and 8 feet in length.

The length of the secondary coil is 54 inches, the diameter is 19 inches, and without the internal ebonite tube containing the primary wire and iron core it is a cylinder 19 inches in diameter and 6 inches thick.

The condenser, made in the usual manner with sheets of varnished paper and tinfoil, is arranged in six parts, each containing 125 superficial feet, or 750 square feet of tinfoil in the whole.

* Abstract of a paper communicated to the Royal Society, by J. P. Gassiot, F.R.S.

A large and substantially made contact breaker, detached from the great coil and worked by an independent electro-magnet, was constructed and worked very well with a comparatively moderate power of 10 or 20 large Bunsen's cells; when, however, the battery was increased to 30 or 40 cells, it became unmanageable.

A Foucault break, with the platinum amalgam and alcohol above it, was now tried, and answered very much better than the ordinary contact breaker; there was no longer any burning or destruction of the contact points, although the great power of the instrument appeared to cause continued decomposition in the water of the alcohol placed above the platinum amalgam; and every now and then the spirit was violently ejected, probably by explosion of the mixed gases taking place in the amalgam, in which they collected in bubbles; the alcohol took fire constantly, and had to be extinguished. A large and very strong glass vessel (in fact, an inverted glass cell belonging to a bichromate battery) was bored through, and the neck fitted into a cap with cement, a thick wire covered with platinum being inserted in the bottom; the platinum amalgam was poured on this, and over it a pint or more of alcohol; the contact wire was also very thick, and pointed with a thick stud of platinum, and, being attached to a spring, contact was easily made and broken. Explosions did not occur, flashes of light could be seen between the amalgam and the alcohol, and the height of the column of the latter prevented the forcible ejection of the spirit, which no longer took fire. The break was used for eight hours in a continuous series of experiments.

The Bunsen's battery used in the experiments was made with the largest porous cells that could be obtained, and each cell contained about one pint of nitric acid.

Some experiments were tried with the battery arranged for intensity, and used with the complete condenser of 750 square feet of tinfoil and 1500 square feet of paper. At first five cells were used, and these gave a spark 12 inches in length. The number of cells were gradually increased until 50 were in operation, when a spark from 28 to 29 inches in length was obtained.

In order to ascertain whether any variation in the size of the condenser would affect the length of the spark, a number of experiments were tried; and it was found that when half the condenser was used the spark increased in length up to twenty cells, but not after.

Experiments were now tried to ascertain whether any increase in the length of the spark could be obtained by arranging the battery and the primary coil for *quantity*, but no material advantage was obtained by this arrangement; even where three groups of cells were connected, a decrease in the length of the spark is observed when compared with the 45 or 50 cells arranged for intensity, the difference being as 20 to 28.

The spark obtained from the large coil is thick and flame-like in its appearance, and therefore it will be alluded to as the "flaming spark."

When the discharging point and circular plate are brought within 6 or 7 inches of each other, the flaming nature of the spark becomes still more apparent.

Two light yellow flames curving upwards appear to connect the opposite poles. If a blast of air from powerful bellows is directed against a flaming spark, the flaming portion can be blown away and increased in area, and thin wiry sparks are now seen darting through it, sometimes in one continuous stream, at another time divided into three or more sparks, all following the direction in which the flame is blown.

The flaming spark is very hot, and if passed through asbestos (supported on an insulating pillar), quickly causes the latter to become red-hot.

When powdered charcoal is shaken from a pepper-box into the flaming spark in a vertical line, and in considerable quantities, the greater part of the light is obscured, and the whole form of the flaming spark presents the appearance of a black cloud with a line of brightly ignited particles fringing the bottom parts. If the charcoal is dusted through in small quantities, each particle becomes ignited, like blowing charcoal into a hydrogen flame.

When the flaming spark is directed on to a glass plate upon which a little solution of lithium chloride is placed, the latter colours the flame upwards to the height of 3 or 4 in the most beautiful manner; and if the point of the discharge is tipped with paper, or sponge moistened with a little solution of sodium chloride, the two colours (the yellow from the salt, and the crimson from the lithium) meet each other, a neutral point being found about half-way, and thus illustrating apparently the dual character of electricity, and that + passes to − electrical, and *vice versâ*.

The flaming spark can be obtained in perfectly dry air.

Whilst passing through common air, if blown against a sheet of damp litmus-paper, the latter is rapidly changed red. In order to ascertain whether the acid product was nitric acid, the flaming spark (9 or 10 inches in length) was passed through a tube connected by a cork and bent tube with a bottle containing distilled water, from which another tube passed to the air-pump; on drawing the air slowly over the spark, and passing the former into the bottle, nitric acid was obtained in large quantities, so much so that it could be detected by the smell and taste as well as by the ordinary tests. The popular notion that nitric acid is always produced during a thunder-storm would therefore appear to be correct. To determine the effect of a cooling surface on the flaming spark, a hole 1½ inches in diameter was bored through a thick block of Wenham Lake ice, and the spark passed through the air in the tube of ice; no change took place, and the spark was still a flaming one.

When the spark was received on the ice, it lost its flaming character, and became thin and wiry, spreading out in all directions.

If the discharging wires were tipped with ice, the spark was always flaming when any thickness of air intervened between them. Even over the ice, if the spark passed a fraction of an inch above the surface, it was always a flaming one, but changed to the thin spark when the point of the discharging wire was thrust into the ice.

If one of the discharging wires of the great coil is brought to the centre of a large swing looking-glass and the other wire connected with the amalgam at the back, the sparks are thin and wiry, aborescent, and very bright; the crackling noise of these discharges being quite different from that of the heavy thud or blow delivered by the flaming spark.

When the discharging-wire is brought close to the flame of the looking-glass, or if a sufficient thickness of air intervenes, the spark again becomes flaming; or, as sometimes occurs, if the discharging-wire is placed about 5 inches from the frame, the spark is partly

flaming and partly wiry, *i. e.*, when it impinges on the glass.

The spectrum is a continuous one with the sodium-line.

When the blast of air is used, and the wiry sparks made apparent, then the nitrogen line appears.

The flaming spark has been ascribed by some experienced observers to the incandescence of the dust in the air, and especially sodium chloride.

To ascertain whether the "flaming spark" could be obtained with a small number of cells, the large Bunsen's battery was reduced to three cells, and it was found that no appreciable spark could be produced when the whole primary wire was used with less than five cells.

By reducing the length of the primary wire, and using the four divisions separately, with five cells the spark was wiry, and varied from 4½ inches to 6½ inches; with ten cells it was wiry, and varied from 8⅛ to 9¾; in the latter the spark was slightly flaming. With fifteen cells the spark was slightly flaming, and varied from 10 inches to 11⅝ inches. With 20 cells a flaming spark varying from 11½ inches to 12½ inches was obtained.

When the two wires from the secondary coil are placed in water, no spark is perceptible, even when the wire was brought very close together, until they touch.

If the negative wire is passed through a cork, on which a glass tube (a lamp glass) is fixed containing a depth of 5 inches of water, and the positive wire is brought within half an inch of the surface of the water in the tube, it becomes red-hot, and if drawn further away from the surface the upper part of the tube is filled with a peculiar glow or light abounding in Stokes's rays.

The experiments with the vacuum tube, and especially Gassiot's cascade, are, as might be expected, very beautiful. When a coal-gas vacuum tube of considerable diameter, and conveying the full discharge from the secondary coil, is supported over a powerful electromagnet axially, the discharge is condensed and heat is produced.

If placed equatorially, the heat increases greatly, and when the discharge is condensed and impinges upon the sides of the glass tube, it becomes too hot to touch, and if the experiment was continued too long the tube would crack.

The enormous quantity of electricity of high tension which the coil evolves, when connected with a battery of forty cells, is shown by the rapidity with which it will charge a Leyden battery.

Under favourable circumstances, three contacts with the mercurial break will charge 40 square feet of glass.

On one occasion a series of twelve large Leyden jars arranged in cascade were discharged; the noise was great; and each time the spark (which was very condensed and brilliant) struck the metallic disk, the latter emitted a ringing sound, as if it had received a sharp blow from a small hammer.

The discharges were made from a point to a metallic disk; and when the former was positive the dense spark measured from 18½ to 18¾ inches, and fell to 8½ inches when the metallic plate was positive and the point negative

Variations of the Leyden jar experiments were tried by connecting the coil worked by a quantity battery of 25+25 cells with six Leyden jars arranged in cascade, and the spark obtained measured 8½ inches.

The same six jars connected with the coil, when the fifty cells were arranged continuously for intensity, gave a spark of 12 inches of very great density and brilliancy.

SCHOOLS OF CHEMISTRY.

EXAMINING BOARDS.

UNIVERSITY OF LONDON.

Candidates for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this Examination is £2.

The Examination includes the following subjects:—

Natural Philosophy.*

Mechanics—

Composition and Resolution of Statical Forces.

Simple Machines (*Mechanical Powers*):—Ratio of the Power to the Weight in each.

Centre of Gravity.

General Laws of Motion, with the chief Experiments by which they may be illustrated.

Law of the Motion of Falling Bodies.

Hydrostatics, Hydraulics, and Pneumatics—

Pressure of Liquids and Gases, its equal diffusion, and variation with the depth.

Specific Gravity, and modes of determining it.

The Barometer, the Syphon, the Common Pump and Forcing-Pump, and the Air-Pump.

Acoustics—

Nature of Sound.

Mode and rate of Propagation of Sound.

Musical Tones.

Optics—

Laws of Reflection and Refraction.

Formation of Images by Simple Lenses.

Chemistry.

Heat—its sources. Expansion. Thermometers—relations between different Scales in common use. Difference between Temperature and Quantity of Heat. Specific and Latent Heat. Calorimeters. Liquefaction. Ebullition. Evaporation. Conduction. Convection. Radiation.

Chemistry of the Non-Metallic elements; including their compounds as enumerated below—their chief physical and chemical characters—their preparation—and their characteristic tests.

Oxygen, Hydrogen, Carbon, Nitrogen. Chlorine, Bromine, Iodine, Fluorine. Sulphur, Phosphorus, Silicon.

Combining Proportions by weight and by volume. General nature of Acids, Bases, and Salts. Symbols and Nomenclature.

The Atmosphere—its constitution; effects of Animal and Vegetable Life upon its composition.

Combustion. Structure and Properties of Flame. Nature and composition of ordinary Fuel.

Water. Chemical peculiarities of Natural Waters,

* The knowledge required of these subjects in Natural Philosophy is such as may be attained by attending a course of experimental lectures.

such as rain-water, river-water, spring-water, sea-water.

Carbonic Acid. Carbonic Oxide. Oxides and Acids of Nitrogen. Ammonia. Olefiant Gas, Marsh Gas, Sulphurous and Sulphuric Acids, Sulphuretted Hydrogen.

Hydrochloric Acid. Phosphoric Acid and Phosphuretted Hydrogen. Silica.

Bachelor of Science (B.Sc.).

This Degree is conferred on candidates who pass a satisfactory examination in Mathematics, Mechanical and Natural Philosophy, Botany and Vegetable Physiology, Zoology, and Chemistry.

First B.Sc. Examination.

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The examination is conducted by means of printed papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *vivâ voce* questions to any Candidate in the subjects in which they are appointed to examine.

The First Examination includes the following subjects:—

Natural Philosophy.

Heat—

Sources of Heat; conduction—convection.

Effects of Heat; expansion generally—of water—of gases and vapours; liquefaction; vaporisation; latent heat; expansive force of steam; dew-point; gases and vapours compared.

Specific Heat.

Thermometers; Pyrometers.

Heat in the Radiant state.

Electricity.

Sources of Electricity.

Static Electricity; dual character—insulation—induction—specific inductive capacity—equivalent antithetic states—disruptive discharge—convection; Electroscopes—Leyden Jar, &c.

Dynamic Electricity; Conduction—the electric current—derived currents—induction of currents; Voltaic Pile and other voltaic arrangements.

Thermo-Electricity; Electro-Thermometer.

Magnetism—

Magnets, the Earth, &c.; Induction—communication—retention—Magnetic relations of iron, steel, &c.

Electro-Magnetism—as in the spark—in conducting media—in soft iron; Magneto-Electricity; principle of Electro-magnetic and Magneto-electric machines.

Terrestrial Magnetism.

Inorganic Chemistry.

Matter; simple and compound.

Elementary bodies classed. Metallic and Non-Metallic bodies.

Chemical Combination and Mechanical Mixture. Solution.

Outlines of Crystallography. Isomorphism. Dimorphism. Allotropic conditions of matter. Chemical Affinity. Laws of Combination by weight and by volume, as deduced from the history of the individual elements. Equivalent Numbers. Equivalent Volumes. Symbolical Notation, including questions on the Unitary System. Formulæ. Nomenclature.

Chemical actions produced under the influence of Heat. Nature of Combustion. Structure and properties of Flame. Principles of Illumination. Chemical action of light. Photography.

Oxygen. Ozone.

Hydrogen. Water.

Nitrogen. Chemical constitution of the Atmosphere. Diffusion of Gases. The Oxides of Nitrogen; Nitric Acid. Ammonia.

Chlorine, Bromine, and Iodine. Their compounds with Oxygen and Hydrogen. Theory of Bleaching.

Fluorine and Hydrofluoric Acid.

Sulphur. Sulphurous Acid. Manufacture and Chemical applications of Sulphuric Acid. Other Oxygen compounds of Sulphur. Sulphuretted Hydrogen.

Phosphorus. Oxygen and Hydrogen compounds of Phosphorus. Theory of Acids. Monobasic, Dibasic, and Tribasic Acids.

Carbon. Carbonic Oxide and Carbonic Acid. The principal Hydrogen compounds of Carbon. Manufacture of Coal Gas.

Silicon and Boron. Their compounds with the elements previously enumerated.

Metals. Characters of Metals as a class. Metallurgical Processes. Alloys. Classification of the Metals.

Potassium. Nitre. Gunpowder. Theory of the action of Gunpowder.

Sodium. Manufacture of Carbonate of Soda.

Barium. Strontium. Calcium. Mortars. Cements.

Magnesium. Aluminium. Glass. Porcelain.

Manganese. Iron. Composition and properties of Cast-Iron, Wrought-Iron, and Steel. Chromium.

Cobalt. Nickel. Zinc. Cadmium.

Lead. Manufacture of White-Lead.

Copper. Mercury. Bismuth. Tin. Arsenic. Antimony.

Silver. Gold. Platinum.

Principal compounds of the Metals with the Non-Metallic elements. Theory of Salts.

Principles of Mineral Analysis.

Principles of Electro-Chemistry.

For the First Examination, a knowledge of Inorganic Chemistry only is necessary.

Examination for Honours.

Candidates for Honours in Chemistry are examined in any of the following subjects, at the option of the Examiners:—

Elementary Substances and their combinations.

Electro-Chemistry.

Radiant Chemical Action.

In the Examination for Honours, the Candidate, being not more than twenty-two years of age, who most distinguishes himself in Chemistry and Natural Philosophy, will receive an Exhibition of Forty pounds per annum for the next two years.

Second B.Sc. Examination.

Candidates for this Examination who have not previously taken the Degree of B.A. shall be required either to have passed the First B.Sc. Examination at least one Academical year previously, or to have passed the First M.B. Examination, in this University.

The Fee for this Examination is £5.

This Examination embraces Organic Chemistry, including the following subjects:—

Ultimate analysis of Organic bodies. Calculation of Empirical Formulæ. Methods of controlling Empirical Formulæ. Determination of the Equivalents of organic acids and bases; examination of products of Decomposition; determination of the Vapour-density of volatile bodies.

Law of Substitution. Compound Radicals. Homologous Series.

The Chemical history of the Cyanogen group. Cyanogen. Hydrocyanic Acid. Cyanic Acid and Urea. Fulminates. Cyanuric Acid. Sulphocyanic Acid. Chlorides of Cyanogen. Uric Acid.

Amylaceous and Saccharine substances. Fermentation. Alcohol, Wine, Beer, Bread, &c.

Homologues of Alcohol. Ethers, simple and mixed. Oxidation of Alcohol. Aldehyd and Acetic Acid, and their homologues. Anhydrides, simple and mixed. Compound Ethers.

Diatomic Alcohols and their Acids. Glycol and Oxalic Acid and their homologues.

Triatomic Alcohols. Glycerine. Fatty and Oily bodies. Saponification.

Vegetable Acids;—the principal.

Ammonia and its derivatives. Ammonia and Ammoniacal Salts. Amides and Amines; their Classification. The chief natural Organic Bases.

Colouring Matters. Indigo and its derivatives. Principles of Dyeing.

The chief constituents of the Vegetable organism. Cellulose. Vegetable Fibrin. Albumin, Casein, Glutin, &c.

The chief constituents of the Animal organism. Animal Fibrin, Albumin, Casein, Gelatin. Blood, Milk, Bile, Urine, &c.

Decay, Putrefaction. Destructive Distillation.

The Chemical principles of the process of Nutrition and of Respiration in Plants and Animals.

Examination for Honours.

The Candidate, not more than twenty-three years of age, who, in the Examination for Honours, most distinguishes himself in Chemistry, will receive Fifty pounds per annum for the next two years, with the title of University Scholar.

Doctor of Science (D.Sc.).

No Candidate is admitted to the Examination for the Degree of D.Sc. until after the expiration of two Academical years from the time of his obtaining the Degree of B.Sc. in this University.

Candidates for the Degree of D.Sc., in any year, must give notice of their intention to the Registrar, and pay to him a Fee of Ten pounds, on or before the 1st of April.

Chemical Candidates can be examined either in Inorganic or Organic Chemistry; but no Candidate will be approved by the Examiners unless he has shown a thorough practical knowledge* of the *Principal Subject*, and a general acquaintance with the *Subsidiary Subject*, or *Subjects*, specified as belonging to the Branch so selected.

* It must be understood that the Candidate for the Degree of D.Sc. is expected to be so fully conversant with the Principal Subject he may select, as to be able to go through any examinational test (whether theoretical or practical) of his acquirements in it that can be fairly applied.

Inorganic Chemistry.

Principal Subject—Inorganic Chemistry.

Subsidiary Subjects—Either Organic Chemistry; or, Mineralogy, Crystallography, and Chemical Technology in its relations to Inorganic Chemistry.

Organic Chemistry.

Principal Subject—Organic Chemistry.

Subsidiary Subjects—Either Inorganic Chemistry; or, Chemical Technology, in its relations to Organic Chemistry, and the Chemistry of Animal and Vegetable Life.

EXAMINATIONS IN CONNECTION WITH THE DEPARTMENT OF SCIENCE AND ART, SOUTH KENSINGTON.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom.

This sum is administered by the Science and Art Department.

The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The following are among the Sciences towards instruction in which aid is given:—Acoustics, Light, Heat, Magnetism, and Electricity, Inorganic Chemistry, Organic Chemistry, Geology, Mineralogy, Mining, Metallurgy.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes are awarded, held at all places complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

Examinations in all the before-mentioned Sciences are held annually about May, through the agency of the Local Committee (which must consist of not less than five well-known responsible persons) in any place in the United Kingdom which complies with the requisite conditions. The Examinations are of two kinds, but held on the same evening and conducted by the same committee. *a.* The class examinations for students under instruction in Science Classes, whether taught by teachers qualified to earn payments on results or not. *b.* The honours examinations, of a highly advanced character.

The class examination is of two grades or stages; the first stage or elementary examination, and the second stage or advanced examination.

Application for examination must be made before the end of March, stating the number of persons and the subject or subjects in which they are to be examined.

At the May class examinations the grades of success are:—in the first stage or elementary paper, first, second, and third class; and in the second stage or advanced paper, first and second class. For the third or lowest class the standard of attainment is only such as will justify the Examiner in reporting that the instruction has been sound, and that the students have benefited by it. The standard may be raised from year to year.

To all successful students are given printed lists of results showing their position. To the first class in both stages Queen's Prizes are given, consisting of Books or Instruments chosen by the Candidates from lists furnished for that purpose.

Four medals—one gold, one silver, and two bronze—are given in each subject for competition among the *bona fide* students of Science Classes who either come within the category of persons on account of whom payments can be earned, or who are under seventeen years of age. The Payments on results are made either directly to teachers or to the committee or managers of the school. Persons are qualified to earn payments who have—(*a*) obtained certificates as teachers in any of the before-mentioned sciences according to the rules in force previous to January, 1867; or (*b*) obtained a First or Second Class at the May examination since that date; or (*c*) who have taken honours at the May examination.

No payments are made to a teacher on account of instruction given in subjects in which he is not so qualified.

The student must have received 25 lessons at least from the teacher or teachers in each subject in which payment is claimed since the last examination, each lesson being an attendance at a meeting of the school of at least three-quarters of an hour's duration on a separate day.

There are two Scholarships provided—the Elementary School and the Science and Art Scholarships. In both cases the scholar must be from 12 to 16 years of age and must have passed in a branch of science at the May examination.

Building Grants for New Schools may be made at a rate not exceeding 2s. 6d. per square foot of internal area, up to a maximum of £500 for any one school, under certain conditions.

A grant towards the purchase of apparatus, diagrams, &c., of 50 per cent on the cost of them, is made to Science Schools and Classes in Mechanics' and similar institutions with a properly constituted committee.

Science teachers who have taught two years consecutively, and passed not less than thirty students each year, are allowed second class railway fare and £3 towards their expenses while living in London for the purpose of visiting the South Kensington Museum and other Metropolitan institutions, in order that they may acquire for the benefit of their students a knowledge of the latest progress in those educational subjects which affect the schools, on condition that they remain there five days at least.

CHEMICAL LECTURES.

UNIVERSITY COLLEGE.

Winter Term (Oct. 4 to March 31).

Chemistry.—Professor Williamson, Ph.D., F.R.S.

Lectures daily, except Saturday, from 11 to 12 a.m.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the Whole Course of Lectures, £6 6s.; for a Half Course, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise-Class—for the Course, £2 2s.; for the Half Course, £1 1s.

The Instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by Tutors, under the direction of the Professor.

Students cannot profit duly by attendance on the Lectures unless they work at the subject of each Lecture so as to make it their own.

Attendance on the Tutorial part of the Class enables Students to do their work more effectually and rapidly than they can do it by themselves.

The First Half of the Course to Christmas includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The following order of subjects is adopted in it:—

Heat.—Instruments for measuring Temperature. Decompositions produced by Heat. Expansion. Tension of Vapours. Conduction. Convection. Calorimeters. Specific Heat. Latent Heat. Evolution of Heat by Chemical Action, and by Mechanical Action. Mechanical equivalent of Heat.

Light.—Photometry. Refraction and Dispersion of Light. Study of Spectrum. Heat Rays. Chemical Rays. Construction of common Optical Instruments. Double Refraction. Polarisation. Chemical applications of Phenomena of Polarisation. Combinations and Decompositions produced by Light and Actinic Rays. Photography.

Electricity and Magnetism.—Simple Magnetic Instruments. Magnetic and Diamagnetic Bodies. Electrical Machine, Electrophorous, &c. Positive and Negative Electricity. Electrometers. Conduction. Inductions. Leyden-jars, &c. Discovery of Galvanism. Various forms of Battery. Study of the Chemical Action of Galvanic Batteries. Galvanometers. Heating Effects of Battery in relation to Chemical Action. Thermo-Electricity. Rheostat, &c.

Oxygen.—Theory of Combustion. Hydrogen. Nitrogen. Composition and chief changes of the Atmosphere. Carbon, Chlorine, Bromine, Iodine, and Fluorine. Sulphur, &c. Phosphorus. Boron. Silicon.

The chief compounds of these non-metallic elements among themselves are studied in relation to their production, properties, and decompositions. The proportions by weight and by volume in which they combine are explained and illustrated in connection with the atomic theory.

The Second Half of the Course, extending from January to March, includes the following subjects:—

I. Preparation and properties of the chief metals, including their characteristic reactions and most important salts. Detection of Metallic Poisons. Quantitative Estimation of Metals. Principles of Classification. Monatomic, Diatomic Metals, &c.

A weekly *vivâ voce* examination is held during the First Half Course and the commencement of the Second Half Course.

II. *Organic Chemistry.*

This commences in the second week in February, and occupies five Lectures weekly till about the end of March. It includes a study of the characteristics metamorphoses of the chief organic acids, bases, alcohols, ethers, colouring-matters, &c. Methods of ultimate and proximate analysis. Determination of molecular weights. Theory of types; of compound radicals. Phenomena of fermentation, &c.

Practical Chemistry.

Mondays, Tuesdays, Thursdays, and Fridays, from 12 to 1.

The course consists of about Forty Lessons, the first twenty being given in the five weeks preceding the Christmas vacation, the remainder immediately after it.

The first half includes the portion of Chemistry required for the Matriculation Examination.

For particulars, see the Prospectus of the Summer Session.

Fee for the course, £4 4s.; Half Course, £2 12s. 6d.

Summer Session (May 2 to July 23).

Practical Chemistry.—Professor Williamson, Ph.D., F.R.S.

I. *Elementary Course.*

About Forty Lessons, of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May. Students are taught the construction and use of apparatus for the preparation of the most important gases, acids, &c. The characteristic tests for the presence of the common acids and bases, including the chief metallic and other poisons. Also the processes for separating these bodies from one another.

Solutions are frequently given in the class for investigation.

The first six weeks of the course are occupied by the study of the chief non-metallic elements, and their simple compounds. Metallic salts, &c., are subsequently studied.

Fee for the Course, £4 4s., including cost of materials and apparatus.

II. *Senior Course.*

About Ten Lessons, of two hours each, on Mondays, from 10 to 12, commencing in the first week in May. The Course includes tests for fixed and volatile organic acids, nitrogenised acids, sugars, glycerine, &c.; organic bases and alkaloids, constituents of blood, milk, urine, &c.

Volumetric methods of quantitative analysis of acids, alkalies, urea, prussic acid, iron, &c., are practised.

Fee for the Course, £2 2s., including cost of materials and apparatus.

III. *Summer Matriculation Course.*

Professor Williamson, F.R.S., assisted by Mr. F. S. Barff, M.A., F.C.S.

This Course includes those parts of Chemistry which are required for the Matriculation Examination of the University of London.

The Course consists of about Twenty Lessons in Practical Chemistry, and of an equal number of Oral Lessons. The Practical Lessons include the preparation of the common gases and acids, &c., and the study of their characteristic properties in relation to the elementary laws of combination.

The other lessons are chiefly devoted to those parts of the subject which require fuller oral explanation than is given in the practical lessons. They include numerous exercises and questions, to which answers in writing are given by the students. These lessons will begin on Wednesday, April 6th, at 11 a.m.

The class will meet on the first five week days, from 11 to 12; and some other Meetings will be announced when the Class has assembled.

Fee for the Class, £4 4s., including cost of materials and apparatus.

Analytical and Practical Chemistry.

Birkbeck Laboratory.

The instruction in the Laboratory is intended for beginners as well as for more advanced students. It includes practice in the construction and use of apparatus for preparing the common gases, acids, bases, salts, &c; study of the qualitative methods of detecting and separating mineral or organic bodies from one another; also quantitative analysis in the wet way, organic analyses, vapour-densities, &c.; instruction in gas-analysis.

More advanced students are instructed in the methods of original research, especially in organic Chemistry.

When accompanied or preceded by attendance on the Lectures on Chemistry, the Laboratory Course qualifies Students in the application of Chemistry to the Manufacturing Arts, Metallurgy, Medicine, or Agriculture, &c. Instruction is given in the principles and processes of Gas Analysis.

The Laboratory and Offices are fitted up completely with the most improved apparatus and utensils for experimental research, both for beginners and for advanced Students. They are open daily, from 9 a.m. to 4 p.m., from the 4th of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials. A deduction of about 40 per cent is made for Students who can attend only three fixed days per week.

A Gold Medal and Certificates of Honour are competed for by Students entered for the Session.

Evening Classes.

The Session is divided into three Terms, each of ten complete weeks, exclusive of vacations—

I. The Michaelmas Term, beginning on Monday, the 11th of October, and ending on Thursday, December 16th.

II. The Lent Term, beginning on Monday, the 10th of January, and ending on Thursday, March 17th.

III. The Summer Term, beginning on Monday, the 21st of March, and ending on Thursday, June 9th, the Easter Vacation extending from the 14th to the 25th of April, both days inclusive.

The object of these Classes is to extend the benefits of the College Tuition especially to gentlemen engaged elsewhere during the day, and to provide Instruction in subjects not taught in the ordinary College Classes.

The Beadles have orders to admit gentlemen to any of the Classes, with the permission of the Professor or Teacher, as occasional visitors.

The Library is open for the convenience of the Students between 6.30 and 8.30 on the evenings when the Classes meet, except when it is wanted for other purposes.

Elementary Chemistry—Theoretical and Practical.

Professor Williamson, F.R.S., and Mr. Jones. Monday, from 7.30 to 9.30.

A Course of Twenty Lessons, of two hours each, in the Michaelmas and Lent Terms.

The elements of Chemistry are explained to the Class, and the experiments illustrating the subject are performed by the Students.

The subject will be the common Non-Metallic Elements and the common Metals, their Compounds and chief Properties, and the best methods of distinguishing and separating them.

All the experiments and analyses are repeated by each Student, or by not more than two Students jointly.

Fee, including the cost of materials, &c., £2 2s. per Term.

ROYAL SCHOOL OF MINES AND COLLEGE OF CHEMISTRY.

Professor of Chemistry.—Dr. E. Frankland, F.R.S.

The instruction in Chemical Science embraces:—

1. A Course of Lectures on Experimental Chemistry, with special reference to the applications of Chemistry in the Arts and Manufactures.

2. A systematic Laboratory Course for the Practice of Chemical Analysis.

Chemical Lectures.—The Course consists of Forty Lectures on Mineral Chemistry and Thirty Lectures on Organic Chemistry.

The Lectures are delivered at the Royal College of Chemistry, Oxford Street.

Chemical Laboratory.—The general Laboratory for instruction in chemical manipulation, in qualitative and quantitative analysis, and in the method of performing chemical researches, is under the direction of Dr. Frankland. The Royal College of Chemistry having become the property of the Government, its Laboratories are used for the instruction of the pupils of the Royal School of Mines.

There are three terms in the collegiate year, of three months each, commencing in the first week of October, January, and April respectively. The Laboratory hours are from 10 a.m to 5 p.m., with the exception of Saturdays, when the Laboratory closes at 2 o'clock.

Each Laboratory Student works independently, there being no classes. All operations are superintended by the Professor and his assistants. A table with drawers, cupboards, and shelves, is appropriated to every pupil. The Institution supplies gas, fuel, and reagents. The larger and more expensive instruments of the Laboratory, such as air-pumps, thermometers, barometers, condensers, &c., may be used by the students, who are held responsible for their safety. The students have to provide themselves only with the apparatus specified in the Laboratory regulations. More advanced students engaged in private researches have to supply themselves with such materials as are not included amongst the ordinary reagents of the Laboratory.

Professor of Metallurgy.—Dr. Percy, F.R.S.

The course of instruction in Metallurgy consists of Lectures and Laboratory practice.

The object of the Lectures is the communication of such instruction as the student may be able to apply to the greatest practical advantage, when he may be subsequently engaged in conducting any metallurgical process.

Metallurgical Laboratory.—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy. The nature of this instruction will be adapted to the special requirements of the Students. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a student who has not furnished satisfactory proof that he is able to obtain accurate results.

There are three terms in the collegiate year, of three months each. The Laboratory hours are from 10 to 4 during November, December, January, and February; and from 10 to 5 during the other months, with the exception of Saturdays, when the Laboratory is closed.

The charge for instruction in the Metallurgical Laboratory is £15 for three months; £12 for two months; and £7 for one month.

Lectures to Working Men.—Short courses of lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within the period of two years, the principal subjects taught at the Institution. Those for the ensuing Session include:—Chemistry, Physics, Applied Mechanics, Metallurgy.

KING'S COLLEGE.

Professor of Chemistry.—W. A. Miller, M.D. V.P.R.S.

Professor of Practical Chemistry.—C. L. Bloxam.

Students of the first and second years are admitted to the Course of Theoretical and Applied Chemistry. The Course commences with a view of the forces which concur to the production of Chemical Phenomena, after which the laws of Chemical Attraction are discussed, and the Non-metallic Elements and their principal Compounds are described.

The metals and their principal compounds are next examined, care being taken to point out the applications of the Science to the Arts, and the processes of the different Manufactures of Metallurgy, and of Domestic Economy, are explained and illustrated.

Examinations of the class, both *vivâ voce* and by written papers, are held at intervals during the course at the usual lecture hour. Dr. Miller has published a work on Chemistry, which is used as a text-book by the class.

Third Year.—Students who have completed six Terms in this Department are admitted to a Course of "Practical Chemistry," consisting of Twelve Demonstrations in each term; and they go through a course of Manipulation in the most important operations of Chemistry, including the first steps of Analysis.

Any Student of this department may be admitted to this Class at any period of his study, on payment of an extra fee.

Experimental and Analytical Chemistry in the Laboratory.—The object of this Class is to afford to Students who are desirous of acquiring a knowledge of analysis, or of prosecuting original research, an opportunity of doing so under the superintendence of the Professor and Demonstrator; Students may enter, upon payment of the extra fees, at any time except during the vacation, and for a period of one, three, six or nine months, as may best suit their convenience. The laboratory hours are from ten to four daily, except Saturday, on which day the hours are from ten till one.

In addition to the Laboratory fee, each Student defrays the expenses of his own Experiments. The amount of this expense, which is comparatively trifling, is entirely under his own control.

Analytical and Experimental Chemistry.—Besides the Course of Chemical Lectures and the Summer Class of Practical Chemistry, provision is made for those Students who wish to become more minutely acquainted with the practical details of the science. By means of this Class each Student is enabled to familiarise himself

with the methods of analysis and research. After passing through a preliminary course of analytical operations, each Student devotes himself to such portions of the science as are most interesting to himself, or most likely to be practically useful to him. The Daniell Scholarship of £20, tenable for two years, is given every alternate year for original research in the Laboratory.

The Fees for admission to the Laboratory Class, exclusive of materials, are, for one month, £4 4s.; for three months, £10 10s.; for six months, £18 18s., &c.

EVENING CLASSES.

Classes for Evening Instruction are held at King's College from October to March, and during April, May, and June.

The Classes include one for the Elements of Chemistry and one for Practical Chemistry.

The fee for the former is £1 11s. 6d.; for the latter £2 2s. The Classes meet twice a week.

PHARMACEUTICAL SOCIETY OF GREAT BRITAIN.

17, Bloomsbury Square, W.C.

School of Pharmacy. The session (1869–70) will commence on Friday, October 1st, and extend to the end of July.

LECTURES ON CHEMISTRY AND PHARMACY, BY DR. REDWOOD.

These Lectures will be delivered on Monday, Tuesday, and Wednesday mornings, at 9 o'clock, commencing on Monday, October 4th.

Part 1.—Physics in relation to Chemistry and Pharmacy.
" 2.—Chemistry of Inorganic Bodies.
" 3.—Chemistry of Organic Bodies.

Also Lectures on Botany and Materia Medica, by Professor Bentley. The first and second parts of this course, extending over the winter months, will be delivered at 17, Bloomsbury Square, on Friday and Saturday mornings, at 9 a.m., commencing on Friday, October 1st. The third part of the course, on Systematic Botany, will be delivered at the Royal Botanic Gardens, Regent's Park, at 8 a.m.

Fees.—For registered apprentices and associates of the Society, for either of the above courses, £1 1s.; for either part separately, 10s. 6d. For those not connected with the Society, £2 2s. for either of the above courses; £1 1s. for either part separately. Students have free admission to the Library and Museum.

Laboratory.—The suite of Laboratories for Practical Instruction in General and Pharmaceutical Chemistry will be opened on Friday, the 1st of October, under the direction of Professor Attfield, Ph.D. Fee for the entire session of ten months, Twenty-five Guineas. The Laboratories are open from 9.30 a.m. till 5 p.m. Students can enter at any period during the session.

Two Scholarships (the Jacob Bell Memorial Scholarship) of Thirty Pounds a year each, are open to competition annually in July.

The Board of Examiners meet monthly, and are required by the Pharmacy Act to examine "all candidates who may present themselves for examination in their knowledge of the Latin Language, in Botany, in Materia Medica, in Pharmaceutical and General Chemistry, and to grant Certificates of Competency."

CITY OF LONDON COLLEGE, LEADENHALL STREET, E.C.

The Annual Courses consist of three terms, each averaging ten experimental lectures; fee, 5s. per term. Subjects:—Junior Class, Chemistry—first year, Non-Metals; second year, Metals and (time permitting) Elements of Organic Chemistry. Senior class, 7 to 8 p.m., Practical Analysis.

LADIES' MEDICAL COLLEGE, FITZROY SQUARE.

The Course of Lectures on Elementary Chemistry by Mr. John Newlands, F.C.S., will commence on Tuesday, October 5th, at 4 p.m., and be continued on successive Tuesdays at the same hour. Ladies will be admitted to the first lecture on presenting their cards at the College. Further particulars may be obtained on application to the Lady Secretary, at 4, Fitzroy Square.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.

EVENING CLASSES.

Chemistry.—Mr. G. Chaloner. Tuesday, 8 to 9.

NEW KENNINGTON INSTITUTE.

Evening Lectures and Practical Classes in Chemistry, under the direction of Dr. Muter.

POLYTECHNIC INSTITUTION.

Course of Thirty Lessons in Inorganic Chemistry, by Mr. G. F. Downar, under the superintendence of Professor Pepper. Tuesday, 8.30 to 10 p.m.

ROYAL VETERINARY COLLEGE, CAMDEN TOWN.

Chemical Professor.—Mr. R. V. Tuson.

LECTURES AT LONDON MEDICAL SCHOOLS.

ST. BARTHOLOMEW'S HOSPITAL & MEDICAL COLLEGE.

WINTER SESSION.

Lecturers.—William Odling, M.B. Lond., F.R.S., Fellow of the Royal College of Physicians, Fullerian Professor of Chemistry at the Royal Institution, and Dr. Matthiessen, F.R.S. Monday, Wednesday, and Friday, at 10 a.m. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. Matthiessen, F.R.S. One course, £2 2s.

CHARING CROSS HOSPITAL AND COLLEGE.

INTER SESSION.

Lecturer.—Mr. C. W. Heaton, F.C.S. Monday, Wednesday, and Friday, at 10. One session, £5 5s.

The Laboratory is open daily.

SUMMER SESSION.

Practical Chemistry.—Mr. Heaton, F.C.S. Monday, Wednesday, and Friday. One session, £2 2s.

ST. GEORGE'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. H. M. Noad, F.R.S. Tuesday, Thursday, and Saturday, at 11.30. One course, £6 6s.

SUMMER SESSION.

Practical Chemistry.—Dr. Noad, F.R.S. Daily, at 10. One course, including the use of apparatus and materials, £4 4s.

GUY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. Alfred Taylor. Tuesday, Thursday, and Saturday, at 11. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Dr. Stevenson. Monday, Wednesday, and Friday, from 10 to 1. One course, £4 4s.

LONDON HOSPITAL.

Introductory Lecture on October 1st by C. Meymott Tidy, M.B., C.M., F.C.S., Lecturer on Chemistry at the Medical College.

Lecturers on Chemistry.—Henry Letheby, M.B., and C. Meymott Tidy, M.B.

The subjects of this course are Physics in their relation to Chemistry and Chemistry Proper. They are alternately made the chief subjects of the course, so that pupils who are studying for the Universities, may, in the period of two Winter Sessions, obtain a full course of Lectures on each subject.

The Lectures are delivered on Monday, Wednesday, and Friday, at 10.30 a.m.

Dr. Tidy has special classes for those reading for the Universities.

Practical Chemistry.—During the Summer Session, Dr. C. Meymott Tidy will deliver a short course of Lectures on Acoustics, in connection with a course on Diseases of the Ear, by Mr. Walter Rivington, M.S., Senior Assistant Surgeon, Lecturer on Anatomy, and Dean.

ST. MARY'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. W. J. Russell, F.C.S. Monday, Tuesday, Thursday, and Friday, at 10.15. £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. W. J. Russell, F.C.S. Tuesday and Thursday, at 11.30 a.m.; and Saturday, at 9 a.m. One session, £3 3s.

MIDDLESEX HOSPITAL.

WINTER SESSION.

Lecturers.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, Friday, and Saturday, at 11. One session £6 6s.

SUMMER SESSION.

Practical Chemistry.—Mr. Taylor and Mr. Heisch. Monday, Wednesday, and Friday, at 11. One session, £3 3s.

ST. THOMAS'S HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. J. Bernays. Tuesday, Thursday, and Saturday, at 11. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Dr. A. J. Bernays. Tuesday and Thursday, 10 to 12; Friday, 11; Saturday, 10 to 1. One course, £3 3s.

WESTMINSTER HOSPITAL.

WINTER SESSION.

Lecturer.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 3 p.m.; Friday, at 3.30 p.m. One course, £5.

SUMMER SESSION.

Practical Chemistry.—Dr. A. Dupré, F.C.S. Tuesday and Thursday, at 10 a.m. One course, £2.

PRIVATE TEACHERS OF CHEMISTRY IN LONDON.

Mr. J. C. Braithwaite, 54, Kentish Town Road, N.W.—Chemistry and Toxicology, Monday and Thursday; Latin, Tuesday and Friday; Botany and Materia Medica, Wednesday and Saturday. All the classes commence at 8 p.m. Laboratory open daily, except Saturdays.

Mr. Henry Matthews, F.C.S.—Laboratory, 60, Gower Street, Bedford Square. Instruction in all branches of Practical Chemistry, particularly in its application to Medicine, Agriculture, and Commerce. Laboratory open daily, except Saturday, from 10 to 5; on Saturday, from 10 to 1.

Mr. A. Vacher, 20, Great Marlborough Street, Regent Street.

Mr. John Newlands, F.C.S.—Laboratory, 13, Knowle Road, Brixton, S.W. Gives practical instruction in Analysis, and prepares gentlemen for various public examinations.

Dr. John Muter, M.A.—Laboratory, 289, Kennington Road. Instruction in Practical Chemistry and Pharmacy.

UNIVERSITY OF OXFORD.

Professor of Chemistry.—Sir B. C. Brodie, Bart., M.A., F.R.S.

Demonstrator.—E. Madan, M.A.

A commodious Laboratory is attached to the New Museum.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other Colleges, by competitive examination in Natural Science.

UNIVERSITY OF CAMBRIDGE.

Professor of Chemistry.—G. D. Liveing, M.A.

MICHAELMAS TERM.

Practical Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 1 p.m.

LENT TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

EASTER TERM.

Chemistry, by the Professor, on Mondays, Wednesdays, and Fridays, at 12.

Practical Chemistry, on the same days, at 1 p.m.

The Chemical Laboratory of the University is open daily, from 10 a.m. till 6 p.m.; so that Students can work there at such times as may be convenient to them; and the Professor will attend to give instruction at the times above specified.

PROVINCIAL SCHOOLS.

BIRMINGHAM.—MIDLAND INSTITUTE.

Lecturer on Chemistry.—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.

Practical Chemistry.—Mr. C. J. Woodward, B.Sc. Saturday, 3 to 6, and 6.30 to 9.30 p.m.

BIRMINGHAM.—QUEEN'S COLLEGE.

WINTER SESSION.

Professor of Chemistry.—Alfred Hill, M.D., Borough Analyst. Tuesday, Thursday, and Friday, at 12.

SUMMER SESSION.

Practical Chemistry.—Professor A. Anderson. Thursday, at 1 p.m.; Friday, at 2 p.m.

BRISTOL.—BRISTOL MEDICAL SCHOOL.

WINTER SESSION.

Lecturer.—Mr. Thomas Coomber, F.C.S. Monday, Tuesday, Wednesday, and Thursday, at 8.15. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. T. Coomber, F.C.S. Daily, except Saturday, at 8 a.m. One course, £3 3s.

ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

Professor of Chemistry.—A. H. Church, M.A., Oxon.
Assistant to Chemical Professor.—E. Kinch.

The Collegiate year is divided into Two Sessions. The Autumn Session commences August 9th, divides October 6th, and ends about December 16th. During each Session, the Lectures given and Practical Classes held in the Chemical department are as follows:—

1. *Inorganic Chemistry*—Thirty-six Illustrated Lectures; Ten Catechetical Lectures.
2. *Organic Chemistry.*—Thirty-six Lectures.
3. *Agricultural Chemistry.*—Twenty-eight Lectures.

1. *Chemical Manipulation.*—Twenty-eight Lessons.
2. *Qualitative Analysis.*—Thirty-six Lessons.
3. *Quantitative Analysis.*—A certain number of Lessons.

The Laboratory is also open several hours each day for advanced Students, who occupy themselves, under the direction of the Professor and his Assistant, with the Analysis of Soils, Manures, Feeding Stuffs, Waters, &c.

LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.

WINTER SESSION.

Chemical Lecturer.—Mr. J. C. Brown, B.Sc., F.C.S. Tuesday, Thursday, and Friday, at 10.15. One course, £5 5s.

SUMMER SESSION.

Practical Chemistry.—Mr. J. C. Brown, B.Sc., F.C.S. Monday, Tuesday, and Friday, at 10.15. One course, £3 3s.

The Laboratory is open daily, from 10 to 4.

SCHOOL OF TECHNICAL CHEMISTRY.

7, Irwell Chambers, Old Hall Street, Liverpool.

Conducted by Mr. A. Norman Tate. Assistants—Mr. Walter Tate and Mr. Arnold Millson.

Pupils may attend at any time between the hours of 9.30 a.m. and 5 p.m. (Saturdays, 9.30 a.m. and 1 p.m.), and may work every day, or any number of days, or portion of a day in the week, and for any period most convenient to themselves.

A separate working bench is provided for each Student; and he will also be supplied with all the ordinary chemicals (with the exception of gold, silver, and platinum solutions, alcohol, ether, and similar costly reagents), books for reference, gas, and fuel, and will be allowed the use of balances and weights, and the most substantial portions of laboratory apparatus; but he must provide himself with test tubes, beakers, and other glass vessels and apparatus of a fragile nature required in his researches.

The Course of Instruction, in addition to the ordinary chemical studies, comprises such other subjects as may be required in the prosecution of the particular branch or branches of Applied Chemistry in which the pupil is to engage; as, for example, in the case of a pupil intended for manufacturing pursuits, he would study architectural and mechanical drawing, so far as is required for the preparation of plans, &c., of chemical apparatus and manufactories, the nature and use of building materials, and the scientific principles and practical rules involved in building and constructive operations, and other scientific and practical information required in the arrangement, construction, and management of chemical manufactories and the application of chemistry to industrial pursuits.

COLLEGE OF CHEMISTRY, LIVERPOOL.

Principal.—Dr. Sheridan Muspratt, F.R.S.E., M.R.I.A., F.C.S., &c.
Assistant.—Mr. Martin Murphy, F.C.S.

The Course of Instruction in this College is entirely devoted to Laboratory work. The term is three months, and dates from time of entrance. Fee for working six days per week, £12 12s.; five days, £11 11s.; four days, £10 10s.; three days, £9 9s.; two days, £8 8s.; and one day per week, £6 6s. Hours of attendance, from 10 a.m. till 5 p.m. The students' laboratories close at 1 p.m. on Saturdays.

Medical students may enter for one hour per day per session. Fee, £3 3s.

Certificates of attendance recognised by the University and Apothecaries' Hall of London, and Apothecaries' Hall of Ireland.

LEEDS SCHOOL OF MEDICINE.

WINTER SESSION.

Lecturer.—Mr. J. Chapman Wilson, F.C.S.

Daily, except Saturday, at 11 a.m. One course, £4 4s.

SUMMER SESSION.

Practical Chemistry.—Mr. Wilson, F.C.S.

Tuesdays and Thursdays, 11 to 12.30. One course, £2 2s.

LEEDS MECHANICS' INSTITUTION AND LITERARY SOCIETY'S LABORATORY.

SESSION 1869-70.

Chemical Classes for Instruction in Elementary, Practical, and Analytical Chemistry.

Teacher.—Mr. George Ward, F.C.S.

The usual Sessional Course of Instruction in abstract and Applied Chemistry will commence on Thursday, September 23rd, at 8 p.m., on which evening the teacher of the classes will introduce the general subject in a Lecture explanatory of its principles, of the mode in which these should be studied, and also of the plan which he purposes to adopt in conducting the classes during the session.

Fees, payable in advance:—Elementary Chemistry, Thursday, per session, £1 15s.; or 5s. 6d. per month. The subscription includes a selection of apparatus and material specially adapted for the course of instruction. To pupils providing their own materials, £1 1s. per session. Organic Chemistry, Friday, per session, 10s. 6d. Practical Chemistry, Tuesday, per session, £1 1s.; or 3s. 6d. per month, including apparatus and material. The session extends over seven months, from October to April inclusive.

HIGH HARROGATE COLLEGE, YORKSHIRE.

Professor of Chemistry.—W. G. Mason, F.C.S., Certificated Science Teacher.

MANCHESTER GRAMMAR SCHOOL.

DEPARTMENT OF MATHEMATICS AND PHYSICAL SCIENCE.

Masters.—T. S. Aldis, M.A. (Cantab.), W. M. Watts, D.Sc. (Lond.); J. Angell, Esq.

There is a large Chemical Laboratory attached to the School, and Chemistry and the various branches of Physics are regularly taught. Arrangements can be made for students to devote their whole time to Physical Science and Mathematics.

MANCHESTER ROYAL SCHOOL OF MEDICINE.

Lecturer on Chemistry.—Mr. Daniel Stone.

The usual course for the Medical Boards.

A Laboratory is connected with the school.

OWEN'S COLLEGE, MANCHESTER.

(IN CONNECTION WITH THE UNIVERSITY OF LONDON.)

Chemistry.—Professor H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

Junior Class.—Wednesday and Saturday, from 9.15 to 10.15 a.m.

Subject: Inorganic Chemistry, comprising the laws of chemical combination, and a description of the properties and mode of preparation of the non-metallic elementary bodies and their most important compounds.

Senior Class.—Tuesday and Thursday, from 9.15 to 10.15 a.m.

Subjects: Inorganic and Organic Chemistry, including the properties of the metals and their compounds, and the composition and relations of the best defined groups of organic bodies, and the laws regulating their formation.

Students are expected to answer the written exercises and attend the *viva voce* examinations given in these classes.

Fee, for each class, £3 3s. For both classes, £5 5s.

A Recapitulatory Lecture, without additional Fee, will be given on Friday at 9.15 a.m., which members of both classes will be required to attend.

Extra Class.—Wednesday, from four to five p.m.

Subject: Technological Chemistry.

The Chemical Principles involved in the most important Chemical Manufactures will be chiefly considered in this course. The subject will be discussed as follows, and as far as time will permit.

1. Production of Heat—Heat of Combustion—Combustibles—Coal.
2. Production of Light—Coal Gas—Measurement of Illuminating Power of Coal Gas—Distillation of Coal.
3. Water and Air, as regards their Sanitary and Technological Relations.
4. Processes concerned in the manufacture and application of the Alkalies.
5. Dyeing and Calico Printing.
6. Manufacture of Acids.
7. Manufacture of Glass and Porcelain.

Students attending this Class must be acquainted with the principles of Chemical Science. Fee, £2 2s.

Analytical and Practical Chemistry.

LABORATORY COURSE.

Professor.—Henry E. Roscoe, B.A., Ph.D., F.R.S.

Senior Assistant.—Mr. C. Schorlemmer, F.C.S.

Junior Assistant.—Mr. T. E. Thorpe, Ph.D.

The aim of this course is to make the student practically acquainted with Chemical Science, to enable him to conduct analysis and original research, and to fit him for applying the science to the higher branches of Art, Manufactures, and Agriculture. To accomplish this, an attendance of not less than four days per week during three whole sessions is as a rule necessary. It is very advisable that each Laboratory Student should attend or should have attended the course of Lectures on Theoretical Chemistry.

The College Laboratory will be open for students daily from 10.30 a.m. until 5 p.m., except Saturdays, when it will be closed at 1.30. The Laboratory is closed from 1.15 until 2, for dinner.

The Laboratory is fitted with every convenience for the prosecution of practical chemistry, all branches of qualitative and quantitative analysis, and original research.

Each student is provided with a separate working table, set of tests, fuel, water, and gas, free of expense; but he is required to find his own apparatus, a few of the more expensive reagents, and the chemicals required for his experiments. Other apparatus or instruments of a more expensive description may be obtained on loan from the Laboratory Steward, subject to regulations to be prescribed by the Professor.

Fees for the Session.—Students working six days per

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week, £21; ditto, four days, £17 17s.; ditto, three days, £13 13s.; ditto, two days, £9 9s.; ditto, one day, £5 5s. Students entering the Laboratory Class at or after Christmas, for not less than two days per week, will be charged two-thirds of the fees for the whole session.

Special Fees for Shorter Periods.—For six months, six days per week, £17 17s.; five months, ditto, £15 15s.; four months, ditto, £13 13s.; three months, ditto, £10 10s.; two months, ditto, £7 7s.; one month, ditto, £4 4s.

Lectures on the methods of Qualitative and Quantitative Analysis, intended to supplement the instruction in Practical Chemistry, will be given by Mr. Schorlemmer, on Mondays, from 4 to 5 p.m.

First year's Laboratory Students are recommended to attend and answer the written exercises and the *viva voce* questions given in this class. Fee, £1 11s. 6d.

Chemical Calculations.—In this class, instruction and special practice is given, by Mr. Schorlemmer, on Wednesday, from 4 to 5 p.m., in the methods of Chemical Calculations, serving as supplementary to the Lecture and Laboratory Courses. Fee, £1 1s.

The Lectures on Chemistry in Owen's College are recognised by the University of London for its Medical Degrees, by the Royal College of Surgeons, and by the Apothecaries' Hall.

EVENING CLASSES.

Chemistry.

Professor H. E. Roscoe, B.A., Ph.D., F.R.S.

Lecture Class (First Course—The Non-Metallic Elements).—Monday, from 8.35 to 9.35 p.m.

Lecture Class (Second Course—The Metals).—Mr. T. E. Thorpe, Ph.D. Friday, from 8.35 to 9.35 p.m.

Lecture Class (Third Course—Organic Chemistry).—Mr. C. Schorlemmer, F.C.S. Friday, from 7.30 to 8.30 p.m.

Laboratory Courses of Practical Chemistry.

Professor Roscoe, F.R.S., and Mr. Schorlemmer, F.C.S.

Junior and Senior Divisions.—Monday, from 6 to 8.30 p.m.

Pharmaceutical Course.—Monday, from 6 to 8.30 p.m.

COLLEGE OF MEDICINE, NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.)

Education in Pharmacy.—The Council of the College have added a Lectureship on Pharmacy to those at present existing. The proposed curriculum for Students in Pharmacy will consist of attendance on Lectures on Botany, Materia Medica, Chemistry, and Pharmacy. The Lectures on the two former of these subjects will be delivered in the summer, and those on the two latter in the winter session of study.

Lecturer on Chemistry.—Mr. A. Freire-Marreco. Monday, Wednesday, Thursday, and Friday, at 4 p.m.

EVENING COURSES.

Chemical Physics.—Every Monday, at 7.30 p.m.

Inorganic Chemistry.—Every Wednesday, at 7.30 p.m.

Practical Pharmacy.—B. S. Proctor. Every Tuesday, at 7.30 p.m.

This course will include—General Processes and Physics applied to Pharmacy—Pharmacopœial Processes, and the most important recent improvements in Pharmaceutical preparations—Dispensing operations—Testing and the Test Solutions of the Pharmacopœia. The course will be illustrated, whenever practicable, with apparatus, experiments, and processes in operation.

Practice of Chemistry.—The Laboratories are open daily throughout the year from 10 to 5 o'clock. Non-Medical students can attend Laboratory practice and receive Instruction in Analysis.

Students attending the Laboratory practice and Lectures on Chemistry, who have passed the Durham Registration Examination, or any Examination in Arts recognised as its equivalent, will be registered on the books of the College as Matriculated Students in Chemistry.

Fees.—Perpetual ticket for Pharmacy Course, £6 6s. (this applies only to Students at present engaged in Pharmacy, and who enter before October, 1871). Separate Courses of Lectures (each), £4 4s. Laboratory Practice, 6 days per week—Three months' ticket, £9 9s.; six months' ticket, £16 16s.; twelve months' ticket, £31 10s. Special arrangements for shorter attendances. These fees admit to all the courses in Chemistry. For a certificate in Chemistry, 10s.

SHEFFIELD.

Mr. W. Baker, F.C.S. Laboratory for Theoretical and Practical Chemistry, 46, High Street, Sheffield.

SCHOOL OF CHEMISTRY.

1, Surrey Street, Sheffield.

Mr. A. H. Allen, F.C.S., delivers a Course of Thirty Lectures on Inorganic Chemistry, in connection with the Science and Art Department.

Day and Evening Classes for Analytical Chemistry.

SHEFFIELD SCHOOL OF MEDICINE.

During the Winter Session, Mr. A. H. Allen, F.C.S., will deliver a Course of Forty-five Lectures on Chemistry.

SCOTLAND.

UNIVERSITY OF EDINBURGH.

Professor of Chemistry.—Dr. A. Crum Brown, F.R.S.

ROYAL COLLEGE OF PHYSICIANS AND SURGEONS, EDINBURGH.

Lecturer on Chemistry.—Dr. Stevenson Macadam, F.R.S.E.

The Courses of instruction in Chemistry include its applications to Medicine, Agriculture, and the Industrial Arts; and they qualify for the University of Edinburgh, and other Universities; the Royal Colleges of Physicians and Surgeons, the Navy, Army, and Indian Medical Service, and the other Medical and Public Boards.

The Lectures on Chemistry commence on Wednesday, November 3rd, and continue to be delivered daily during the five months of the Winter Session. The Lectures form a complete Course; the New Nomenclature and Notation are employed throughout, and spe-

cial Lectures in Technological Chemistry are given. Tutorial Class Examinations are held during the Session, and Excursions are arranged for visiting the principal Chemical Manufactories.

The Instructions in Analytical Chemistry are conducted in the Laboratories at Surgeons' Hall, which are now open daily, under the personal superintendence of Dr. Macadam, for the instruction of gentlemen in Chemical Analysis, and the prosecution of researches in Manipulative Chemistry.

The Prelections in Practical Chemistry are also conducted in the Laboratories at Surgeons' Hall. The subjects selected for Examination are those with which Medical Students are specially called upon to exhibit a practical acquaintance.

Fees.—Lectures, £3 5s. (University Graduation, £4 4s.); Practical Chemistry (University, &c.), £3 3s.; Analytical Chemistry, £2 per month, £5 for three months, or £10 for six months.

ANDERSONIAN UNIVERSITY, GLASGOW.

Professor of Chemistry.—Dr. Penny, F.R.S.E., F.C.S., &c.

1. Systematic Course of Lectures and Demonstrations on Chemistry, for Medical Students, Manufacturers, Civil Engineers, Agriculturists, &c. Daily, except Saturday, from 12 to 1, commencing 27th of October and terminating in April, £2 2s.

The object of this Course, which comprises upwards of 100 Lectures, is to convey to the student a thorough knowledge of the principles of Chemistry, and the applications of the science to Medicine, Manufactures, Agriculture, &c.

Certificates of attendance on these Lectures are received by the Royal College of Physicians of London and Edinburgh; by the Royal Colleges of Surgeons of England, Ireland, and Edinburgh; by the Faculty of Physicians and Surgeons of Glasgow; by the Army, Navy, and East India Boards; and by the Apothecaries' Halls. They also qualify for Graduation in the University of London, &c.

2. Instruction in the various branches of Practical Chemistry, and Analysis in the Laboratory. Daily, from 10 to 4.

After the usual preparatory training, the attention of the Student is specially directed to the examination and analysis of Minerals, Products of Commerce and Manufacture, Manures, &c., and, when desired, to Original Research.

3. The Private Laboratory for Commercial and Mineral analyses and assays, and for consultations and special investigations. Open daily, from 10 to 5, throughout the year.

4. Evening Course of Popular Lectures on the General Principles of Chemistry, and its application to the various branches of the Useful Arts. On Fridays, at 8.30.

Students attending this Course have the privilege of competing for the Prizes and Certificates offered by the Society of Arts, and the Government Department of Science and Art.

5. Evening Course of Instruction in Practical Chemistry and Analysis. On Thursday, from 7 to 9.

6. Summer Course of Practical Chemistry for Medical Students. Three months, commencing in May, £2 2s.

Young's Chair of Technical Chemistry.—This new Chair, which has been founded by Mr. James Young in connection with the Andersonian University, has been accepted by Mr. W. H. Perkin, F.R.S. We hear that the Laboratory will be opened in January next, and will accommodate about forty students.

UNIVERSITY OF GLASGOW.

Professor of Chemistry and Practical Chemistry.—Dr. Thomas Anderson, F.R.S.E.

GLASGOW MECHANICS' INSTITUTION.

Lecturer on Chemistry.—Dr. R. Carter Moffat.

1. Course of six months morning Lectures, qualifying for the various Medical Examinations, and also suited to the requirements of Manufacturers, Civil Engineers, &c. Daily, at 10. Begin 25th October.

2. Day and Evening Experimental Classes are held in the Laboratory, by Dr. R. Carter Moffat. Hours, from 10 till 4, and 7 till 9.

In these Classes, Students are instructed individually, and not as members of a class, so that every facility is given for the thorough attainment of the various principles and methods in Analysis, &c. Students may enter at any time; and the Classes are suitable for beginners as well as for advanced pupils. All are supplied with Apparatus, &c., and they personally perform their own Experiments. Those desiring it may take up, on entering, any department they choose—as, for example, the Analysis of Substances for Trade purposes, or investigations relative to the Improvement of certain Manufacturing Processes, and the Discovery of New Materials useful in the Arts, &c.

3. Popular Evening Lectures, every Monday, at 8.30, for six months.

4. Medical Students' Practical Class in Summer, commencing May 3rd. £2 2s.

GLASGOW VETERINARY COLLEGE.

Professor of Chemistry and Materia Medica.—Dr. R. Carter Moffat.

The Session will commence on Monday, October 25th, 1869.

IRELAND.

DUBLIN.—TRINITY COLLEGE.

Professor of Chemistry.—Dr. Apjohn, F.C.S.

The Lectures will commence on Wednesday, November 2nd, at 2 o'clock, and be continued each Tuesday, Thursday, and Saturday.

ROYAL COLLEGE OF SURGEONS, DUBLIN.

Professor of Chemistry.—Dr. Barker.

The Professor receives operating pupils into the Chemical Laboratory.

QUEEN'S COLLEGE, BELFAST.

Professor of Chemistry.—Dr. Andrews.

QUEEN'S COLLEGE, CORK.

Professor of Chemistry.—Dr. Blyth.

QUEEN'S COLLEGE, GALWAY.

Professor of Chemistry.—Dr. T. H. Rowney.

A Laboratory for Practical Instruction is attached to all the Queen's Colleges. The usual Practical Course for the Medical Boards is given in the summer.

ROYAL COLLEGE OF SCIENCE FOR IRELAND,

Stephen's Green, Dublin.

This College supplies, as far as practicable, a complete course of Instruction in Science, applicable to the Industrial Arts. The Subjects of Instruction are:—Pure and Applied Mathematics, Descriptive Geometry and Mechanical Drawing, Mechanism, Theoretical and Applied Chemistry, Chemical Analysis, Physics, Botany, Zoology, Geology and Paleontology, Mineralogy, Mining, Machinery, Surveying, and Agriculture.

Professor of Theoretical Chemistry.—W. K. Sullivan, Ph.D., V.P.R.I.

Professor of Analytical and Applied Chemistry.—R. Galloway, F.C.S.

Assistant Chemist.—Wm. Plunkett, F.C.S.

A Course of Lectures on Inorganic and Organic Chemistry is delivered by Dr. Sullivan three times a week during the Session. Fee for the entire course, £2.

A Course of Lectures on Technological Chemistry is delivered by Mr. Galloway twice a week during the session. Fee for the course, £2.

The Chemical and Metallurgical Laboratories, under the Direction of Mr. Galloway, are open every week day during the session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical research. Each student is taught, not in class, but separately and independently; and he is supplied with a separate working table, with reagents, fuel, water, gas, and the larger and more expensive apparatus. Fee, for the session of nine months, £12; or for three months, £5; or for one month, £2.

Students have access to the extensive Library of scientific books in the College, and have the privilege of borrowing the books.

There are four Royal Scholarships, of the value of £50 each, yearly, with free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with free Education, including Laboratory Instruction, tenable for three years; three become vacant each year. These are awarded at the annual May Examinations of the Science and Art Department.

A Diploma of Associate of the College is granted at the end of the three years' Course.

The Session commences on Monday, October 4th.

NOTICES OF BOOKS.

Abridgments of Specifications Relating to Acids, Alkalies, Oxides, and Salts. A.D. 1622—1866. Printed by order of the Commissioners of Patents. London, 1869.

We have here before us, condensed into a neat volume containing about 1100 small octavo pages, a most useful as well as a most valuable record of the history and course of inventions on the domain of practical and technical chemistry for a period of nearly two and a half centuries. The number of specifications, from the earliest period to the end of the year 1866, amounts to no less than 59,222.

This work, besides embracing all inventions relating to the making or obtaining by any direct or indirect methods of acids, alkalies, oxides, or salts, includes inventions relating to the making or obtaining of several elementary bodies; among which are bromine, iodine, chlorine, fluorine, carbon, hydrogen, nitrogen, oxygen, and sulphur, and some compounds—as, for instance, cyanogen.

There is in this excellent work such an *embarras de richesse* as regards the subjects for quotation that it is very difficult to make a choice out of such an abundance of matter. For curiosity's sake, we quote, from the first page, the following:—

A.D. 1623, February 23, No. 23.—Jones, Roger, and Palmer, Andrewe, "Makeing of hard soape with a material called berilia, and without the vse of any fire in the boyling and makeing thereof; and also of makeing of soft soape without the use of fire in the boyling thereof." The "berilia" consists of ashes of "beanestrawe," "peasestrawe," and of English kelpe. *Queritur*—What is, in this phrase, the meaning of the words "without fire?" Does it refer to saponification in the cold? or was steam already used by some for boiling other liquids? Since no specification is enrolled, this question remains unanswered.

This work, to which are added copious indices of subject matter, and of names, will be highly welcomed, both by manufacturers and parties directly interested in patents, and specifications thereof; the work is a valuable addition, also, to the scientific bookshelves and libraries of the day; and the whole manner of execution and abridging of abtruse matters, too often very imperfectly worded, reflects great credit upon the gentlemen to whom the excellent head of the Patent Office has entrusted a task which deserves the praise of all who can understand the difficulty of the proper execution of that task.

Notwithstanding that the book contains nearly 1100 closely-printed pages, it is sold at a very reasonable price, while the paper and typographical execution are also commendable.

Alkali Act, 1863; *Fifth Annual Report by the Inspector of His Proceedings during the year* 1868. Presented to both Houses of Parliament. 1869. Eyre and Spottiswoode.

It will be in the memory of all of us that, in 1863. Lord Derby brought in a bill for the removal of the nuisance caused by alkali works. It had long been noticed that, in the neighbourhood of such works, no kind of vegetation could flourish; and other evils were found to result. It was hence proposed that means should be adopted for preventing the escape of hydrochloric acid into the air, and that an Inspector should be appointed to see that the enactments of the bill were properly carried out. Inasmuch as the bill was entirely free from any party influence, it rapidly received the assent of both sides of both Houses, and became law somewhat more than five years ago. Dr. Angus Smith was appointed Inspector, and he has annually issued a report, that which we are about to notice being the fifth.

In the report for 1867, the escape from the hydrochloric acid condensers was stated to be under 1 per cent, while 2 per cent was allowed for leakages through the brickwork. No diminution of this amount can be shown for the succeeding year, although, in the case of "open-furnace works," the escape is much smaller, and is considered to be not more than 0·5 per cent, leakage included. Various new furnaces have, however, been constructed, and it is confidently expected that the escape may ultimately be reduced to almost a vanishing quantity.

From page 6 to page 22, the space is occupied by accounts of various alkali works, and the improvements effected during the year; and first in the case of works with open roasters:—

No. 53. To each condenser is connected a wash-tower containing 400 cubic feet of condensing space. The escaping gases were found to be reduced in temperature 400° F. between the roaster and condensers; the acid obtained was of 19° Twaddle, and the escape was 0·9 per cent.

No. 115. These are new works, and consist of one decomposing pan,,a pan condenser 60 feet high, containing 2,400

cubic feet of condensing space, and one roaster condenser with two shafts, each containing 1400 cubic feet. Charge, 6 cwts. per hour; escape, 1·9 per cent.

No. 68. The escape varied from 1 to 5 per cent.

Secondly, in the case of works with close roasters:—

No. 45 March 3.—Two spots with flanges and rims, and close furnaces are used. A large quantity of acid found in the flue. April 7.—A large quantity of acid found in flue. July 16.—A new furnace, constructed with great care, was set to work; but the results were unsatisfactory, and the escape large. Ultimately, after many trials, another new furnace was set to work, on November 12th, and the result was found to be satisfactory, and the escape of acid small. However this may be, the above results sufficiently indicate the advantage of the "open-furnace" system, unless there are certain drawbacks connected with it in reference to other matters than the provisions of the Alkali Act. The testing-glasses of Mr. Kane continue to work well, and to indicate with precision an undue escape of acid into the flues. The main difficulty appears to be to prevent leakage through the hot brickwork of the furnaces, since the amount of acid escaping with the smoke can be reduced by condensation to certainly 0·5 per cent, and, by lessening the velocity of the escaping current, to even less than this.

In regard to the matter of cooling flues, experiments have been made as to the relative cooling powers of brick and iron flues, with the following results:—

An underground brick flue cooled 7° F. per 10 feet.
An overhead brick flue cooled 18° per 10 feet.
An overhead cast-iron flue cooled 30° per 10 feet.

Thus the iron flues are most advantageous as regards cooling effect, but they are somewhat rapidly acted upon by the evolved gases, and do not last so long as brick flues. The following analyses show the composition of the deposits from cast flues in Mr. Mease's works. The "up pipe" was 65 feet from the furnace, and the temperature 468° F. The "down pipe" was 130 feet from the furnace, and the temperature 289° F.

Analysis of the Deposit in Cast-Iron Flues.

	Up pipe.	Down pipe.
Peroxide of iron	19·866	26·946
Alumina	3·171	4·614
Lime	0·371	0·486
Magnesia	0·414	0 298
Soda	11·311	2·808
Sulphuric acid	53·212	48·077
Chlorine	2·141	2·034
Water, loss, &c., in addition.		

A number of estimations of the sulphur in coal have been made by Dr. Angus Smith and Mr. Fletcher. An examination of 70 specimens of South Lancashire coal by the former showed an average percentage of 1·1 of sulphur; while the examination of some specimens of St. Helen's coal by Mr. Fletcher showed a minimum of 0·6, and a maximum of 2·22, per cent of sulphur. If 300 cubic feet of air are used to burn 1 lb. of coal containing 2 per cent of sulphur, the amount of sulphurous acid in the smoke will be a little more than 1 grm. in a cubic metre, since that is equal to 35·318 cubic feet.

A number of very interesting analyses are given of the composition of coal-smoke (pp. 26 to 34), from which we extract the following:—

Chimney of a sugar refinery, 200 feet high. Smoke taken from a height of 30 feet from the ground. Speed of smoke, 12 feet per second. Internal diameter of the chimney at 30 feet from the ground, 10 feet. Amount of coal burnt per day, 35 tons.

	Black smoke.	Common brown smoke.
CO_2	6·64	4·26
CO	0·40	—
O	11·17	16·63
H	—	—
CH_4	0·02	—
CnH_{2n}	—	—
N	81·77	79·11
	100·00	100·00

One hundred cubic feet of black smoke were found to contain, in addition to the above gases, 1047·44 grains of water, and 18 52 grains of soot.

It was considered very advisable that the condition of the air at some distance from alkali works should be known; and this, as regards its acidity, would be obviously best determined by examining the rain-water collected direct in porcelain vessels.

The maximum acidity (*calculated as sulphuric acid*) of rain which fell in Manchester in 1857 was 7·3960 grains per gallon, and the minimum o 3169 grains per gallon.

Pendleton, Manchester. 1857.

Maximum acidity, 3·3810 grains per gallon.
Minimum " 0·2641 " "

Hulme, Manchester. 1857.

Maximum acidity, 2·5886 grains per gallon.
Minimum " 1·3734 " "

Rain; Manchester. 1868.

Maximum HCl, 1·2775 grains per gallon.
Minimum " 0·0278 " "
Maximum $HOSO_3$, 5·6000 " "
Minimum " 1·4000 " "

The total acid in rain collected from various sources bears the following relationship:—

Row, Dumbartonshire	100·00	= 1
Whiston, ten miles from Liverpool	470·67	= 4¾
Birkenhead	528·29	= 5¼
Liverpool	938·21	= 9⅜
Waterloo, on the shore	961·98	= 9½
Newcastle-on-Tyne	1054·73	= 10½
Manchester	1175·54	= 11¾
Near an alkali work	1539 27	= 15⅜

We can scarcely be surprised, after glancing at this table, at the rapid decay of stone in certain localities, compared with others, and the long endurance of buildings of antiquity which are far from large towns, and in a pure and open air—such as the Parthenon, and the Pyramids of Egypt.

Some very interesting drawings are given by Dr. Angus Smith, on page 46, of the microscopic appearance of rain-water residues; and we are told that oxide of iron, sulphate of soda, phosphates, chloride of ammonium, and other substances may be readily detected in the rain of some localities. We are surprised to find that Dr. Smith has not examined any of the residues spectroscopically, as this would appear to offer the best means of detecting the minute traces of substances which are present; or is it that, in point of fact, almost every element would be detected by such an infinitely delicate test? Certainly, Bunsen has found that lithia is generally present in the air near the sea shore. Accordingly to M. Robinet (*Comptes Rendus*, 1863, p. 493), the Paris rain-water contains a substance which gives a garnet-red precipitate with nitrate of silver. In a summary of results obtained, Dr. Smith gives, among others, the following conclusions:—

"The rain from the sea (Western Islands) contains chiefly common salt, which crystallises clearly.

"The sulphates increase inland before large towns are reached.

"The sulphates rise very high in large towns, because of

the amount of sulphur in the coal used, as well as decomposition.

"When the air has so much acid that two or three grains are found in a gallon of the rain-water, or forty parts in a million, there is no hope for vegetation in a climate such as we have in the northern parts of the country.

"Free acids are not found with certainty where combustion or manufactures are not the cause.

"Experiments in the direction indicated above may enable us to study and express in distinct language the character of a climate, and certainly of the influences of cities on the atmosphere."

In the Appendix to the Report will be found an interesting letter by Mr. A. E. Fletcher, "On the Speed of Air in Flues," as determined by the ether anemometer invented by himself, and described some time ago in this journal (vol. xvi., p. 141). The tables will be found of especial value: the one giving the corrections for temperature in a range of from 0° to 1000° F.; the other to show the conversion of the anemometer indications into the speed of the air current, with a range from 0·903 to 40·37 feet per second.

The report, as a whole, contains much valuable information, and is an important contribution to our knowledge of technology. Its range extends far beyond the more immediate subject of inquiry. The composition of the air of towns, as indicated by the solid residue of the rain, affects all of us, not alone as regards our health, but further, in relation to the preservation of our national monuments and public buildings. The comparison of the death-rate of various towns indicates the influence of impure airs upon the duration of our lives. Dr. Angus Smith has done much towards the examination of the influences of impure air and water upon mankind, and we hope he will continue his labours in the same fertile field.

Arithmetical Exercises for Chemical Students. By C. J. Woodward, B.Sc., Lecturer on Chemistry and Physics, Midland Institute, Birmingham. Birmingham: The Educational Trading Company (Limited). London: Simpkin, Marshall, and Co.

We have received, under the above title, a series of ten very neatly printed cards, enclosed in a case. Instead of "Exercises for Chemical Students," it would have been better to write Students of Chemistry.

The author very properly and truly states that, in almost all examination papers on the subject of chemistry, there are introduced questions involving considerable arithmetical calculation. Each card of this series contains all the data necessary for working the problems, and certain questions, which may be looked upon as *type* questions, are worked out in full. The subjects include—(1) the metric system of weights and measures; (2) the conversion of thermometer scales—correction of gases for pressure and temperature; (3) specific gravity; (4) formula of a body being given, required either its percentage composition, or the quantity of any constituent a given weight of it will contain; (5) percentage composition of a compound being given, required its empirical formula; (6) quantity of material to yield, liberate, or produce a given weight of a substance; (7) required the bulk of a substance produced in certain decompositions, or, conversely, the volume of a substance necessary to effect certain decompositions; (8) combinations and decompositions of bodies in the gaseous form; (9) the crith and its uses; thermal units (by "crith" is understood the weight of 1 litre of hydrogen at 0° C., and 760 m.m. Barometer); (10) specific, atomic, and latent heat.

Very opportunely, these cards have been published at the moment that the courses of lectures are commenced at the various schools in the kingdom. A careful perusal justifies us, we think, in recommending these cards to all students of chemistry and physics; and a number of teachers will also find them a very useful addition to their library-table. As far as perusal goes, we have no fault to find with this work; and its very moderate price, especially considering the large amount of highly useful information contained in ten duodecimo cards, holds out a good inducement for students who really desire to obtain, within a very small compass, a permanently-useful pocket companion to purchase this work.

CORRESPONDENCE.

Impurity of Indigo.

To the Editor of the Chemical News.

Sir,—Having been in the habit of experimenting on indigo, in order to arrive at a relative value of different samples, in order to rate the proper quantities for dyeing stated quantities of fabric, I was not under the necessity of examining the article for anything but its active colouring principles. But, a short time since, in making sulphate of indigo, I poured the solution from the dregs, and, throwing the sediment away, I kept the solution in a glass-stoppered bottle, exposed to strong light, and, at the end of a couple of months (not being at leisure to attend to this lot sooner), I found, on examination, that the contents of the bottle were almost solid, only about one-fifth of the whole being liquid.

I filtered the fluid portion from the solid, and obtained only a very small quantity of indigo carmine as result of examination, the solid mass being composed of a dirty blue powder, which I washed away, being anxious to get at the principal matter in the mixture. After washing thoroughly, I obtained a heavy lot of fine, white needles, which had formed during the time that the solution was standing. Some blue spots adhering, I washed with dilute nitric acid, and then with water, obtaining the crystals tolerably clean.

I have consulted Watts's "Dictionary," and other works at my command, and, of all the reactions mentioned in connection with any of the salts of indigo, not one of them makes an impression on the mass.

Tested with SO_3, NO_5, HCl, and with aqua ammonia, sulphuric ether, alcohol, hot and cold water, also a solution of caustic potassa, none of which have any effect, as a drop on glass dries off without leaving a crystalline residue to show solution having taken place.

Heated to a cherry-red heat, the silky needles lose their pearly brilliancy, but still obstinately refuse to answer any of the reagents applied to them.

I have not applied hydrofluoric acid for fear of using all my stock of crystals up without arriving at a satisfactory solution, and have none left to send you.

I transmit herewith the balance of the crystals left in good order for your inspection, hoping you can throw some light on the compound.

The indigo from which these were obtained is an article known in the American market as "Madras" indigo, and, as this must indicate very extensive adulteration, I have ventured to trouble your patience with a history of it, in the hope that it may be of interest. If the subject is worth further efforts, I am ready to follow any suggestions as to the mode of procedure you may see fit to offer.

In conclusion, I will state that the SO_3 used to form the sulphate was bought as being chemically pure, but I did not test it; although, if it had been sophisticated with sulphate of soda, the result would not have been an insoluble compound, and, as the indigo was pounded fine in a mortar, and passed through a very fine sieve, the crystals could not have been in their present shape previous to the examination of the specimen.—I am, &c.,

New Berne.

New Berne, N.C., U.S.A., July 27th, 1869.

[The substance of which our correspondent sent a sample proves to be soluble in boiling dilute hydrochloric acid. This solution yields a dense precipitate with chloride of barium, a flocculent precipitate with ammonia (alumina), and a strong precipitate with oxalate of ammonia. It is evi-

dently a mixture of sulphate of alumina and sulphate of lime: other tests which have been applied confirm this statement. If the indigo had been ignited, our correspondent would have been able to judge of its quality from the quantity of ash. Good indigo leaves from 4·5 to 5·0 per cent. of ash; but the less the better, of course. A mixture of pipe-clay and milk of lime is frequently used in the preparation of indigo; hence the phenomenon which puzzled "New Berne."—*Ed.* C.N.]

Improved Bunsen's Filter.

To the Editor of the Chemical News.

Sir,—Bunsen's filter being now in such general use, and such a necessary adjunct to a good laboratory, it seemed to me that any small improvements in connection with it could not fail to interest your readers.

In the place of the cone of platinum foil recommended by Bunsen, I now use a cone made either of platinum or copper gauze. When the fluid which passes through the filter does not act on copper, I prefer the latter. The cones are cut just as Bunsen describes, but can be fitted to the funnel direct, that is without the use of a matrix of plaster-of-Paris. This is accomplished by pressing the cone into the funnel to be used, with a piece of wood turned as nearly as possible to the proper angle. I may add that during the last three months, in which these cones have been in almost daily use, I find them to filter much quicker than the foil cones, and with quite as little risk of breaking the paper.—I am, &c.,

R. S. Dale, B.A.

Cornbrook Chemical Works, Hulme, Manchester, September 8th, 1869.

MISCELLANEOUS.

Explosion caused by Ammonia Gas.—M. Werner.—On the 18th of February last, an explosion took place at the chemical works of Messrs. Kunheim & Co., Berlin. It appears that a large iron vessel of cylindrical shape, 6 feet in diameter, and 4½ feet high, and 13-16ths of an inch in thickness, was used for the evolution of ammonia gas from a somewhat thickish magma; but this operation had been carried on in the same manner for twenty years, and with iron vessels of similar description, which were properly renewed when required. It was this apparatus which exploded; and the author states that the vessel was strong enough to withstand a pressure of 20,000 pounds to the square inch. The apparatus have since been provided with safety-valves; for it appears that the explosion took place immediately after the apparatus had been filled with about 4000 lbs. of ammoniacal liquor, and that the explosion was the joint effect of steam and ammonia gas. The iron apparatus was found to be throughout well made, of good quality and strength, and only a suddenly-applied force would break it.—*Zeitschrift des Vereines Deutscher Ingenieur.*

Testing Acetic Acid.—The value of commercial acetic acid can be estimated by ascertaining how much soda, or carbonate of soda, a given weight can neutralise. Inorganic acids, if present, would also neutralise the alkali; they must be tested for separately, or the determination corroborated, by evaporating the neutralised liquor to dryness, and calcining it at a red heat. All the acetate of soda is then converted into carbonate, the quantity of which may be dosed by the test acid; if it corresponds in quantity with the alkali first required to neutralise the acid, there is no mineral acid present; if it falls short the difference may be ascribed to some mineral acid, the soda-salt of which is not decomposed by red heat. Good commercial acetic acid contains from 18 to 22 per cent of anhydrous acetic acid, and traces only of sulphates and chlorides. When 100 grains of acetic acid neutralise 62 grains of crystallised soda, the acid contains 23 per cent of anhydrous acetic acid. Acetic acid should be tested for lead and copper, for sulphuric, hydrochloric, and nitric acids, should be entirely volatile on being boiled, and, when concentrated, its vapour should readily ignite on being approached by any flame. The strength of vinegar can also only be determined by the same means as indicated for acetic acid. When acetic acid or vinegar are evaporated to dryness on a water-bath, after addition thereto of a few drops of a strong clear solution of loaf-sugar, there should not ensue a deep brownish or black coloration on the residue becoming dry, which would indicate the presence of sulphuric or hydrochloric acids. Vinegar always contains sulphates and chlorides, and, if deeply coloured, also organic matter; the presence of the salts just named is due to the water applied in making the vinegar. Acetic acid should be free from tarry matters and aceton; they will be discovered on gently evaporating, and also on saturation, best with pure carbonate of lime.

Professor Church, M.A.—The *Lancet* of August 28th in noticing a report read at the Exeter meeting of the British Association, "On the Spectroscopic Examination of Animal Substances," refers to Professor Church's investigation of the red colouring matter of the wings of the turaco, and believes that Professor Church is the Assistant Physician to St. Bartholomew's Hospital. We have been requested to state that the investigator is not Dr. W. Church of St. Bartholomew's Hospital, but A. H. Church, M.A, Professor of Chemistry at the Royal Agricultural College, Cirencester.

New Chemistry Chair at Anderson's University.—A special meeting of the trustees of Anderson's University was held on Wednesday last for the purpose of considering the proposal of Mr. James Young, of Kelly, to found a chair of technical chemistry in connection with the University. Mr Harvie was called to the chair. A letter was read from Mr. Young, intimating his intention to invest £10,500, in six trustees and himself, for the purpose of establishing a chair of technical chemistry, and requesting the managers and trustees to lease to him the building adjoining the University recently presented by Mr. William Euing, to be altered and fitted up by the trustees. The managers had given their assent, and they now asked the concurrence of the trustees. The Secretary read the deed of trust by Mr. Young in favour of his trustees, directing how the 10,000 guineas were to be appropriated in providing for the lecturer, providing apparatus, altering the building, &c. The trustees were empowered to establish bursaries, scholarships, &c. His six trustees must be trustees of Anderson's University. It was intimated that Mr. Young, with the consent of his fellow trustees, appointed Mr. W. H. Perkin, F.R.S., to the lectureship. This gentleman, like Mr. Young himself, is the founder of an important chemical industry, he being the first discoverer in the department of the aniline or coal-tar dyes. The offer was accepted, with one dissentient.—*Scientific Opinion.*

Spiders' Silk.—A bar of iron 1 inch in diameter was sustain a weight of 28 tons; a bar of steel 50 tons; and, according to computation, based upon the fact that a fibre only 1-4000th of an inch in diameter will sustain 54 grains, a bar of spiders' silk 1 inch in diameter would support a weight of 74 tons.

Contribution to the History of Pyrrol.—No Lubavin.—It is pretty well known that this substance is the product of the destructive distillation of bones, pit-coal, and other nitrogenous substances. Pyrrol has been only slightly submitted to research. It is known to have the formula C_4H_5N. It does not form salts; is not decomposed by fusing with caustic potassa. Treated with acids, it yields pyrrol-red; while it has the property of colouring a piece of fir-wood, previously moistened with hydrochloric acid, red. About two years ago, M. Goldschmidt discovered that, when pyrrol is oxidised with moist oxide of silver, it is converted into a crystalline substance endowed with the properties of an acid. However, only a very small quantity of this substance was obtained by him. M. Lubavin, although operating upon

large quantities of pyrrol, succeeded no better than M. Goldschmidt, when repeating his researches on pyrrol and its oxidation by means of oxide of silver; while the very small quantity of the crystalline substance obtained by him by this reaction proved to be as ready a reducing-agent for the said oxide as the pyrrol itself. Pyrrol appears to be extremely indifferent to any reagents at all, or, if acted upon, is readily converted into pyrrol-red. Sodium does not affect pyrrol at the ordinary temperature of the air: when heat is applied, some gas is disengaged. Potassium, however, acts strongly upon pyrrol; a large quantity of gas is disengaged; heat is developed; and on cooling, the entire mass solidifies, forming a crystalline compound; this appears to be pyrrol-potassium, since, on treating it with water, pyrrol is obtained unchanged while, on treating it with iodide of ethyl, ethyl-pyrrol is produced. The potassium combination has the formula C_4H_4 KN. When large quantities of pyrrol are operated upon, some resinous substance is also produced. Ethyl-pyrrol is a colourless liquid, which, however, soon becomes first yellow, next red. Its smell is akin to that of oil of turpentine. It is hardly at all soluble in water, and specifically lighter than that fluid. Ethyl-pyrrol becomes resinous when exposed to air; is soluble in hydrochloric acid, thereby becoming deep-red coloured, and emitting dense white fumes. On boiling this solution, no solid substance is deposited, but, on addition of an aqueous solution of caustic potassa, an amorphous, solid substance is precipitated. The vapours of ethyl-pyrrol have the same characteristic property as pyrrol, viz., to render red-coloured a piece of fir-wood previously moistened with hydrochloric acid. The percentical composition of ethyl-pyrrol for the formula $C_4H_4(C_2H_5)N$=Carbon, 75·8; hydrogen, 9·5; nitrogen, 14·7. The boiling point is between 160° and 175° C.—*Berichte d. Chem. Gesel. z. Berlin.*

Non-Poisonous Colours.—We have received two samples from Mr. F. Pettit, viz., yellow zinc and green zinc; and, after having tested them, we are satisfied that the statements made by the makers of these colours are correct. Of the beautiful yellow and green pigments we have had the opportunity of testing, we affirm with pleasure that (1) they are not poisonous: (2) they do not become discoloured by the effects of burning gas; (3) they are not affected by sulphuretted hydrogen gas, and are not altered in shade—as far especially as the green is concerned—by artificial light. For paper-stainers, the manufacture of surface-coloured paper, for mixing with plaster-of-Paris for ornamental stucco work on walls, these colours will answer well, as they also will for mixing oil pigments, while, for pigment cotton printing, chromo-typography, and lithography, they will supply colours of great brilliancy, durability, and quite sufficient body.

London Gas.—It is stated that one hour after the gas of London is lighted the air is deoxidised as much as if 500,000 people had been added to its population. It is also stated that, by the burning of gas twenty-four hours in London, more water is produced than would supply a ship laden with emigrants on a voyage from England to Australia.

Artificial Light.—The German chemist Landsberg says that artificial light contains 90 per cent of calorific rays, while sunlight contains only 50. To the number of these rays he attributes the disagreeable sensation produced upon the eyes by artificial light. By passing it through alum or mica, the calorific rays are interrupted, and the light rendered more agreeable and less injurious.

The Humboldt Centenary.—On the 14th of September, 1769, was born Alexander von Humboldt. According to the *Moniteur Belge* of this date, 1869, there is a plan on foot at Berlin to found and establish a Humboldt Palace, wherein would be united together the libraries of all the literary and scientific societies existing at Berlin, all of which would have their meeting rooms in that palace also.

Death of the Master of the Mint.—With sincere regret, we learn that Professor Thomas Graham, F.R.S., Master of the Mint, died on Thursday night, the 16th Sept., at his residence in Gordon Square. Mr. Graham succeeded Sir John Herschel at the Mint in April, 1855, and was, at the time of his decease, in his sixty-fourth year. He was born at Glasgow, on the 20th of December, 1805. He was the son of a Glasgow merchant, and was educated at the Grammar School and the University of that city, and afterwards spent some years in Edinburgh. He returned to Glasgow, where he distinguished himself as a practical chemist, and was elected Professor in the Andersonian Institution. In 1837, he was appointed Professor of Chemistry in University College, London, and, in 1855, he was appointed Master of the Mint. To the duties of this office he applied all his varied scientific knowledge, and, at the same time, devoted himself to original investigations in his favourite science. To him we are indebted for the discovery of the laws of the diffusion of gases, the diffusion of liquids, and the new method of separation known as dialysis. More recently, his analysis of an aërolite, which he found to be partly composed of hydrogen, afforded an interesting confirmation of the results obtained by spectrum analysis as to the constitution of heavenly bodies. His "Elements of Chemistry" is a standard work, and has had a large circulation both in England and Germany, the German translation being edited by Professor Otto, of Brunswick. In 1836, Mr. Graham became a Fellow of the Royal Society. In 1848, he was elected a Corresponding Member of the Academy of Sciences of the Institute of France; and, in 1855, the University of Oxford conferred upon him the honorary degree of D.C.L. The loss of the deceased *savant*, who was a bachelor, will be very seriously felt in the scientific world and also at the establishment of which he was the head, where he has rendered eminent service to the nation at large by the introduction of many great improvements.

The Whitworth Scholarships.—The following candidates have been reported to the Science and Art Department as entitled to the ten Whitworth scholarships of £100 a year each:—William H. Greenwood, aged 23, engineer, student at the Mechanics' Institution, Manchester, 143 marks; Thomas A. Hearson, aged 23, engineer, student, Royal School of Naval Architecture, 137 marks; John Hopkinson, B.Sc., aged 19, student at Cambridge University, 134 marks; Thomas S. Elgood, aged 24, mechanical engineer, Leicester, and Owen's College, Manchester, 127 marks; George A. Greenhill, aged 21, student at Christ's Hospital School and Cambridge University, 116 marks; John R. Brittle, aged 23, engineer, student at Sir Walter St. John's School, Battersea, 113 marks; Thomas W. Phillips, aged 23, student at British School, Millwall, and Royal College of Science, Dublin, 100 marks; Richard Sennett, aged 21, engineer, student at the Royal School of Naval Architecture, 98 marks; Robert B. Buckley, aged 21, engineer, student at Merchant Taylors' School, 97 marks; Charles E. Leeds, aged 23, B.A. (Oxon.), student at Oxford University, 96 marks.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the very generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of EVERY CHEMICAL PAPER IN THE WORLD, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers on a level with the latest advances of science.*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Journal für Praktische Chemie, No. 10 (*Continued.*)

Sulphoxybenzoic Acid.—M. Senhofer.—The author

has prepared this acid, and many of its salts, in pure state. Referring to some by-products, among which is protocatechusic acid, the author also discovered some non-crystallisable compounds, which are intermediate between benzoic and paraoxybenzoic acids, on the one hand, and protocatechusic acid on the other. Analogous products are obtained when anhydrous phosphoric acid acts upon eugenol and bitter oil of almonds.

Protocatechusic Acid.—Dr. Malin has prepared this acid from sulpho-anisic acid, and obtained from about 12 to 15 per cent of very pure protocatechusic acid. The author intends to obtain from this acid methyl and ethyl derivatives.

Violet Pigment.—Professor Hlasiwetz.—The author obtains from binitrated naphthol, by means of the reducing action of cyanide of potassium, a beautifully violet-coloured pigment, which has great similarity with indigo. No particulars are given about this discovery, neither about the process by which this substance is obtained. This very brief and imperfect notice is only intended *pour prendre date.*

Iodbenzyl.—M. A. Lieben.—When hydriodic acid acts, at the ordinary temperature, upon chloride of benzyl, iodbenzyl only is formed; this is a solid, crystalline substance, fusing at 24°. Since this body is very ready to undergo double decomposition, it is very suitable for the preparation of benzyl compounds.

Action of Hypochlorous Acid upon Butylen.—M. A. Lieben.—The author says:—The chief product of this action is butylen-chlorhydrin; when this is treated with water and an amalgam of sodium, a butylic alcohol is formed, which, on oxidation, yields acetic acid. That alcohol is, therefore, ethyl-methyl-carbinol, and is identical with the alcohol which is obtained from butylen and hydriodic acid and subsequent saponification.

Solubility of Carbonate of Lime in Water Saturated with Carbonic Acid.—M. A. Cossa.—A great many years ago, Professor Bischof, at Bonn, called attention to the fact that the state of aggregation had a great influence upon the solubility of carbonate of lime in water saturated with carbonic acid. The author has studied this subject, and, starting with pure white Carrara marble, has extended his researches over a dozen varieties of carbonates of lime, including chalk, Iceland spar, dolomite, oölithic limestone, and artificially-prepared carbonate of lime. The chief results are as follows:—1000 parts of water, saturated with carbonic acid at the atmospheric pressure (reading of barometer) at the time of the experiment, and at temperatures varying from +7·5° to 28°, dissolve of Carrara marble—at from 7·5° to 9·5°, 1·181 parts; at from 20° to 22°, 0·9487 parts; of Luneberg chalk, 0·835 parts; of artificially-prepared (precipitated) carbonate of lime at 18°, 0·950 parts: of oölithic limestone, 1·252 parts at 15°; of dolomite, from Monticello, 0·573 parts at 15°.

No. 11, 1869.

This number opens with a brief notice of the death of one of its editors, the late Dr. Gustav Werther, Professor of Chemistry at the University of Königsberg, Prussia.—The deceased was born at Rossla, on the Harz, on the 1st of August, 1815, and died, on the 29th of June last, at Königsberg. For fully seventeen years the deceased was one of the editors of this periodical.

This number contains the following original papers:—

Researches on Fergusonite.—M. Hermann.—Under the name of fergusonite, such minerals are known as are chiefly made up of an acid of one of the niobium metals and yttria, and belong to the tetragonal system of crystals. These minerals have been found as yet only in Greenland; in Sweden, near Ytterby; in Norway, near Arendal; and a few other localities in these countries. Since Mr. Forbes found alumina and water in two kinds of the fergusonite found near Hampemyr, and since the Greenlandic mineral does not contain these substances, Mr. Forbes believed that these Norwegian fergusonites were peculiar minerals, and named them tyrite and bragite. The author of this paper states that other chemists did not find any alumina in these fergusonites, while the quantity of water was found to vary between 1 and 6·44 per cent. As regards the substances designated as niobic acid, several quite different compounds are named; for instance, the niobic acid of the Columbites is (TaO_3,NbO_3,HO_3); the niobic acid of Æschynite is (NbO_2,HO_2); the niobic acid of Samarkite consists of (HO_2,TaO_2,TiO_2), and, moreover, of a peculiar metallic acid as yet but imperfectly known. The author has tried to elucidate these matters, and has analysed a sample of very pure fergusonite from Hampemyr; the sample selected weighed 360 grains, and was imbedded in granite. After having been separated from its matrix, this mineral exhibited a glassy lustre; colour, brownish black; in powder, cinnamon-brown; hardness, 6; sp. gr., 5·31. When heated in a small flask, the mineral decrepitates and gives off water. After having lost its water, the mineral could not be fused when held between platinum-pointed forceps in the flame of a spirit-lamp. On being thus heated, the colour of the mineral changes to yellow; heated before the blowpipe-flame with borax, the reaction of uranium is exhibited; loss on ignition, 3·75 per cent of water. The not-previously-ignited mineral is readily fused and disintegrated with bisulphate of potassa. The metallic acid of the fergusonite from Hampemyr consists, according to this author's researches of two atoms of niobous-niobic acid and one atom of ilmenous-ilmenic acid. In 100 parts, this mineral consists of:—Stannic acid, 0·06; niobous-niobic acid, 29·56; ilmenous-ilmenic acid, 13·82; titanic acid, 0·67; zirconia, 4·02; thoria, 3·44; oxide of cerium, 0·77; yttria, 37·15; protoxide of uranium, 3·43; protoxide of iron, 1·43; lime, 1·90; water, 3·75; and traces of protoxide of manganese and oxide of lead. The author, in this very extensive and exhaustive essay, quotes a large number of analyses of various species of this mineral, but space forbids to enter into more details on this subject.

Researches on the Composition of Samarkite, and Observations on the Chemical Constitution of the Niobium Metals.—M. R. Hermann.—The author states that, though there are a large number of analyses of samarkite in existence, these analyses are, in this aspect, imperfect; that, at the time they were made, the more delicate methods for estimating small quantities of tantalic, niobic, and ilmenic acids were unknown. The author then reviews, at length, the labours of various chemists and mineralogists on this subject; and next enters, at great length, into very minute details of methods of analysis. The chief result of his researches, as regards samarkite, gives, for that mineral, the following percentage composition:—Stannic acid, 0·35; titanic acid, 4·94; tantalic acid, 3·40; ilmenous-ilmenic acid, 24·57; a peculiar acid, 26·61; thoria, 4·47; yttria, 14·00; protoxide of uranium, 10·58; protoxide of iron, 10·70; magnesia, 0·34. The author next enters into lengthy particulars about some minerals which are homo-morphic and poly-morphic with samarkite. The paper ends with an essay on the constitution of the niobium metals.

Water of the Hydrosilicates.—Dr. F. von Kobell.—The author begins with some observations on water of crystallisation and so-called basic water. He next calls attention to the fact that the silico-hydrates of magnesia, and some minerals, as, for instance, prehnite, euklase, and others, contain water, which is only expelled by long-continued and strong ignition. Dr. Rammelsberg has suggested that this so-called basic water is not contained in the minerals as water, but exists therein as hydrogen and

oxygen, and is only formed, combined, when the ignition takes place; but the author thinks that this opinion does not explain sufficiently the reason why the water of the hydrosilicates should be expelled so difficultly and unequally by heat. Since the oxides of different metals behave differently when submitted to heat in respect of giving off part or whole of their oxygen, the author of this memoir thinks that a somewhat similar cause may operate in respect of the more or less readiness wherewith minerals part with their so-called basic water. In this, however, should be taken into account the time the heat acts, and the degree to which it is applied. In this latter respect, the author has made some experiments with a few minerals, submitting them, first in lumps, next in powder, and in weighed quantities, repeatedly for a known time to the same degree of heat. A piece of analcime weighing 4·74 grms. did not lose all its water after four ignitions, while the same weight of the same powdered mineral lost its water entirely after three ignitions, all of the same duration of time.

On Aspidolite.—M. von Kobell.—This mineral—the hardness of which is about 2; sp. gr. 2·72—consists, in 100 parts, of:—Silica, 46·44; alumina, 10·50; magnesia, 26·30; protoxide of iron, 9·0; soda, 4·77; potash, 2·52; water, 1·13.

Paragonite from Virgenthal, Tyrol.—M. von Kobell.—There occurs, at Virgenthal, a greenish-coloured mineral, which has great likeness to nephrite, and is applied for ornamental purposes, after having been cut and polished. The sp. gr. of this mineral is 2·9. In 100 parts, it consists of:—Silica, 48·00; alumina, 38·29; peroxide of iron, 0·91; soda, 6·70; potassa, 1·89; magnesia, 0·36; water, 2·51.

On Atractylic Acid.—M. Lefranc.—This acid occurs in the root of the *Atractylis gummifera* in the shape of atractylate of potassa, which may be obtained from the root by exhausting it with boiling water, evaporating this solution, and taking up the residue with alcohol of 85 per cent, purifying with animal charcoal, and recrystallisation from alcohol. The atractylic acid is obtained in free state by decomposing the potassa salt with acetate of lead, and by next decomposing the atractylate of lead thus formed with dilute sulphuric acid. The atractylic acid so obtained is a colourless fluid, having a sour, but, at the same time astringent, bitterish-sweet taste; reddens blue litmus-paper; is not precipitated by chloride of barium; cannot be obtained in concentrated form; and is decomposed on being boiled and converted into sulphuric and valerianic acids, sugar, and resin. Formula, $S_4O_{12}, C_{60}H_{52}O_{20}$.

Naphthalin and Anthracen (Paranaphthalin).—Dr. Vohl.—The author calls attention to the naphthalin and anthracen manufactured by Messrs. Gerhartz & Co., at Cologne. These gentlemen have succeeded, by means of an improved method of manufacture, in obtaining the two substances just named in perfectly pure state, and in solid bars or discs, akin to those of white wax. The author has tested these substances, and found them to be quite free from creosote and oily matters. The same firm also manufactures nitro-derivatives of these substances in pure state.

On Hartite.—M. Rumpf.—By this name is understood a peculiar hydrocarbon (C_5H_5), found some years ago near Gloggnitz, among the coal of the Oberhart district. The author obtained a sample of this rather rare mineral from Voitsberg and Köflach, in Styria, and found that, crystallographically, this mineral belongs to the *triklinic system*. The elementary organic analysis of this specimen led to results giving the same formula as above stated. This mineral appears to occur among lignitic brown coal, and is evidently formed during the peculiar eremacausis the wood is subjected to.

Cresylo-Purpuric Acid.—Dr. von Sommaruga.—The author obtained this acid, $C_9H_7N_5O_6$, by a process which is not described in the brief notice given on this subject. The author states that, while studying the products of decomposition of trinitrocresylic acid and cyanide of potassium, he discovered, besides cresylo-purpuric acid, a peculiar compound, which, after having been purified, appears to exhibit great analogy with indigo in many respects. M. Hlasiwetz has obtained a somewhat similar compound from dinitronaphtol. Both authors are engaged in further researches on this subject.

Aminamides of the Fatty Acid Series.—Dr. Linnemann.—The author has particularly studied the behaviour of formamides—for instance, ethylformamide, prepared by him by means of a simple process, towards such substances as withdraw water from these bodies (*Wasserentziehende Mittel*). He found that carbylamines are not formed, as stated by Messrs. Chapman and Smith, but that carbonic oxide, carburetted hydrogen, and ammonia make their appearance. Ethylacetamide behaves in the same manner under the same conditions; but diacetamide, obtained by a peculiar process, not described in this notice, is decomposed into aceto-nitrile and acetic acid when acted upon by materials which are capable of withdrawing water from these bodies.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, May and June, 1869.

These two numbers have been published together, stitched in one cover.

We abstract from this the following original matter:—

Contribution to the History of Buxine.—M. Flückiger.—The author begins this paper with an historical introduction, going back as far as the year 1636. Next he discusses at great length the pharmacognostical differences of *Radix Pareiræ bravæ*, *Cissampelos Pareira*, *Botryopsis platyphylla*, and thereupon alludes to pelosine, an alkaloid discovered in 1838, by Dr. Wiggers, in the Pareira. This alkaloid the author assumes to be identical with bibirine. This latter alkaloid is stated to be identical with buxine, a substance discovered, in 1860, by Walz, in the leaves of the *Buxus sempervirens* (box-tree). Buxine, according to this author, is an alkaloid identical with those already named, and a substance not simply met with in the leaves and bark of the box-tree, but far more generally dispersed through the vegetable kingdom, and especially met with in the natural families of the Euphorbiaceæ, Laurineæ, Rubiaceæ, and others. Buxine is very difficultly obtained in a pure state, since it is naturally accompanied by a peculiar substance called buxoflavine. Buxine is characterised by the property that its concentrated solution in hydrochloric acid is precipitated by nitrate of potassa, chloride of ammonium, and iodide of potassium, which latter salt precipitates even the dilute solutions of buxine copiously.

The Colouring Matter met with in the Common Buckthorn Bark.—M. Faust.—After reviewing the labours of Messrs. Ferber, Binswanger, Buchner, Casselmann, and others, on this subject, the author states that frangulin is the chief active principle of the bark in question. Frangulin is a glucoside; its formula is $C_{20}H_{20}O_{10}$; it fuses at 226°; is soluble in alkalies, exhibiting a beautifully purple coloured solution. When the alcoholic solution of frangulin is boiled with one-third of its bulk of hydrochloric acid, this material is split up into sugar and frangulinic acid, $C_{14}H_{10}O_5$. This acid crystallises, exhibiting yellow-coloured crystals; readily soluble in alcohol and ether, but very difficultly so in water; also readily soluble in dilute aqueous solutions of alkalies, and in ammonia exhibiting a magnificent red colour. The acid fuses at about 249°. Acids precipitate from the alkaline solutions of frangulinic acid the latter acid in unaltered state.

Researches on Hydroborocalcite.—Dr. Gracger.—The author says about twenty-five years have elapsed since M. Hayes discovered, near Ibique, in South America, a borate of lime, which, according to his researches, consisted, in 100 parts, of:—Lime, 18·89; boracic acid, 46·11; water, 35·00. Since the time this analysis was made, the mineral locally known as teza has become an article of commerce, and is brought over to Europe with the view of being applied to the manufacture of boracic acid and borax. According to the author, this mineral, which is chiefly found in nodules among the nitrate of soda beds of Peru, when dried at 100°, has, in 100 parts, the following composition:—Borate of lime, 52·39; borate of soda, 10·23; sulphate of soda, 1·06; chloride of sodium, 3·76; residue insoluble in acid, 4·23; water, 28·33.

The Manufacture of Borax from the Native Borate of Lime.—Dr. Graeger.—The author states that, since he found that what is stated in treatises and handbooks on chemistry concerning pure borate of lime is generally quite erroneous, he commenced by studying the properties of that substance more minutely. Pure borate of lime is only slightly soluble in pure water, 100 parts of which, at about 18°, only dissolve from 0·304 to 0·333 parts of that salt; boiling water does not dissolve, perceptibly, more of this salt. A solution of pure borate of lime in water behaves, with the following reagents, in the following manner:—Ammonia, no precipitate; caustic potassa solution, very slight precipitate, due to a trace of carbonate present along with the caustic alkali; carbonate of ammonia, copious precipitate, soluble in excess of precipitant; carbonates of potassa and soda, permanent precipitates; neither the nitrate of protoxide, nor of peroxide of mercury, nor, also, neutral chloride of iron, exhibit any reaction with the solution in question; solution of sulphate of copper gives a greenish blue precipitate. Since borate of lime is less soluble, even in alcohol, than sulphate of lime, a solution of the former salt in water containing only 100oth part of the salt is readily precipitated by alcohol containing 60 per cent of absolute alcohol. The presence in solution in water of some salts, especially chloride of sodium and ammonium, largely increase the solubility of borate of lime in water. Such acids as form with lime readily soluble salts, do readily dissolve borate of lime, both pure and native; and from such solutions, if concentrated, boracic acid is precipitated. The portion of this paper relating to the manufacture of borax and boracic acid from the native borate of lime alluded to, is rather a practical receipt for the proper performance of this branch of industry, and, therefore, not well suited for abstraction, the less so as the price of fuel, soda, and other things necessarily influence the applicability of the borate of lime for that purpose.

Glycerine as a Substitute for Spirits of Wine for the Preservation of Zoological and Anatomical Preparations.—Dr. Koller.—The author recommends concentrated glycerine as being cheaper, not liable to evaporation, not combustible, and, moreover, as better preserving the natural colour of various preparations usually kept and preserved in spirits of wine. According to the author, glycerine answers this purpose eminently.

New Method of Fusing Difficultly Decomposable Minerals.—Dr. Vorwerk recommends that 1 part of the previously very finely-powdered mineral should be mixed with 3 parts of fluoride of sodium, and that this mixture, after having been placed in a platinum crucible, should be covered with 12 parts of powdered bisulphate of potassa. Minerals such as chrome iron ore, hard hæmatite, tin ores, and rutile, corundum, and the like, are very readily brought to fusion and disintegrated by this flux, even with no more heat than that obtained from a good Bunsen gas-burner.

Sindor Oil and Sindor Balsam.—M. Maier.—These substances are used externally, in some diseases of the skin, by the Javanese. The real sindor tree belongs to Borneo, and is called there pohonsinampar. The balsam investigated by the author has the consistency of balsam copaivæ, and exhibits a smell not unlike the latter substance; sp. gr. at 27·5°, 0·9221. The sindor balsam boils at 255°; burns, when heated to a higher temperature, with a flame emitting much soot and smoke; on being distilled along with water, the balsam left a reddish brown-coloured transparent resin. The balsam is difficultly soluble in alcohol, and on being brought into contact with strong sulphuric acid, became blood-red coloured. The essential oil, obtained by distilling the balsam with water, was of a light yellow colour, very fluid, boils at between 245° and 250°; sp. gr. at 27°, 0·914; soluble in from 4 to 5 parts of cold, and from 1 to 1½ parts of hot alcohol. The author extended his researches to other balsams, which, though bearing the same name, are evidently either obtained from different trees, or have undergone peculiar preparations whereby their physical and chemical properties are very much altered. As to the trees yielding these balsams, the eminent botanist, M. Teysmann, who has resided for upwards of forty years in Java, states that they are not precisely known.

Distinction between Gum Arabic and Gum Senaar.—M. Schlosser.—According to the author, these two kinds of gum are not, as generally supposed, different only in quality from each other, but the senaar gum is undoubtedly derived from another tree. The behaviour of these two kinds of gum with acetate of lead is, according to the author, a ready means of distinguishing between the two with certainty; take 3 grms. of pure gum arabic, dissolve in 15 grms. of water, add gradually, and while stirring the mixture, 30 grms. of acetate of lead (from the wording in the original, it is impossible to infer whether an aqueous solution is meant or the dry salt in powder) there thus ensues a whitish precipitate, forming a rather thickish magma, which is transferred to a filter, the filtrate, about 18 to 20 grms., running off, exhibiting a hardly even opalescent fluid; the filtration is finished in an hour's time, and the residue left on the filter is no more fluid; take about 6 grms. of the filtrate, add 5 grms. of pure water and 1½ grms. of liquid ammonia, specific gravity 0·960, the fluid will remain quite clear, and even if, after twelve hours' time, a sediment were deposited, this does not amount to more than ¼ c.c. When gum senaar is treated in the same way it yields a milky filtrate; the filtration is extremely slow, and even after twenty-four hours the substance on the filter appears fluid. When 6 grms. of this filtrate are treated precisely as just described, the contents of the test tube, on being shaken about, become solidified, exhibiting a gelatinous mass.

A New Preservative Against Fire.—M. Reinsch.—The author states that, having been requested to report to a fire insurance company about the best means of preventing timber bursting into flame, he experimented with various salts, and at last came to the conclusion, as the result of his experiments, that impregnating timber with a concentrated solution of rock salt is as good, if not better, a preservative against its bursting into flame as water glass (silicate of soda), while the price of the former salt is, of course, only a mere trifle; moreover, rock salt thus applied to timber is a preservative against dry rot and noxious insects. The author recommends the use of salt water, that is to say, a solution of rock salt of moderate strength for the use of fire engines during a fire as by far more effective than water; but in order that the salt should not injure the working parts of the engines, they will immediately afterwards have to be played with fresh water again.

Cosmos, August 28, 1869.

This number contains, amongst its very varied information, the following:—

What becomes of Old Shoes.—They are cut up in small pieces, and these are put for a couple of days in chloride of sulphur, the effect of which is to make the leather very hard and brittle. When this is found to have been

effected, the material is withdrawn from the action of the chloride of sulphur, washed with water, dried, ground to powder, and mixed with some substance which causes it to adhere together, for instance, shellac or any other resinous material, or also good glue or thick solution of gum; it is then pressed into moulds and shaped into combs, buttons, knifehafts, &c.

The Poisoned Fountain.—In La Limagne, Département Puy de Dôme, France, carbonic acid is nearly everywhere given off in smaller or larger quantity from the limestone formation which occurs there. Near Aigueperse, a town in the Département just named, a locality exists which is popularly named the "poisoned fountain;" it consists of a round hole placed in a depression of the soil, and this hole contains somewhat turbid water, from which carbonic acid constantly escapes, accompanied by a noise as if steam were blowing off from the safety valve of a steam boiler. It often happens that birds and other animals which come near this hole to drink from the water it contains, are asphyxiated at once by the carbonic acid. Such sources are often found in volcanic districts; near Naples the well-known "Grotto del cane" occurs, and the "Death valley" in the island of Java is the most extensive instance of this kind known.

Comptes Rendus des Séances de l'Académie des Sciences, August 16, 1869.

This number contains, among a large number of purely mathematical, mathematico-physical, and papers on other subjects not at all allied to chemistry, the following memoirs:—

Constitution of Luminous Spectra.—M. Lecoq de Boisbaudran.—The author says, in the year 1865, I stated "that, when the spectral rays of the metals of the alkalies and alkaline earths are classified according to their refrangibility, they are placed according to the chemical properties and the atomic weights of these bodies." The author now says—"I can explain the formation of the spectra by the four following points:—1st, the molecules should present certain inequalities, and should not be solids rotating round a circular axis; 2nd, they must be in rapid motion; 3rd, that motion ought to be an eccentric elliptic; 4th, the ellipse itself should move in a perihelical manner. From the combination of the spherical and elliptical movements, I can explain the formation and the entire mode of existence of a spectrum; that is to say, groups which are repeated in several points of the luminous part, shadowed rays or stripes decreasing either towards the right or left hand, and repetition of these stripes in the spectrum."

Researches on the State Salts are in when Dissolved in any Menstruum.—MM. Berthelot and St. Martin.—The authors find—1st, that there do not exist in solution acid salts formed by a monobasic acid; 2nd, the acid salts formed by a bibasic acid are, when in solution, partly decomposed; 3rd, the quantity of salt thus decomposed increases steadily and continuously when dilution takes place; 4th, the quantity which is decomposed varies according to the relation existing between the neutral salt and the excess of acid; the stability of the acid-salt is increased by the presence of a neutral salt, or by the presence of excess of acid. The authors have, moreover, found that—1st, the acetates of the alkalies are entirely decomposed, when in aqueous solution, by sulphuric, hydrochloric, oxalic, and even tartaric acids; 2nd, ammonia, when added to solutions of acetate or oxalate of potassa, or soda, in solution, does not seize upon any of these acids; 3rd, oxalic acid partly decomposes a solution of chloride of sodium, when, in a litre of water, 14 grms. of oxalic acid and 20 grms. of chloride of sodium are dissolved (larger quantities of these substances cannot be taken, on account of the difficult solubility of binoxalate of soda). The authors found that about 1-10th of the oxalic acid was converted into binoxalate of soda.

Fermentation of Fruit.—MM. Lechartier and Bellamy.—In this paper the authors relate their experiments whereby they discovered that fruit—apples and pears, more especially—when kept, gives off carbonic acid; but, at the same time, in the interior of the fruit, alcohol and acetic acid are formed. We quote the following figures:—Duration of experiment, 184 days; weight of apples, 348·8 grms.; loss of weight, 14·3 grms.; loss of sugar, 26·0 grms.; gas given off, 13·10 grms.; alcohol formed, 10·01 grms.; acetic acid formed, 0·11 grm. From these and some other experiments made by the authors, it appears that fruit of the kind alluded to is best and most advantageously kept so as to admit of free circulation of air round every individual fruit as much as possible. To keep fruit in closed vessels causes rapid destruction.

On Bromotoluen and the Toluidines derived therefrom.—MM. Rosenstiehl and Nikiforoff.—This paper is a critical review of the labours of MM. Koerner, Huebner, and Wallach, and not suited for abstraction.

On Propylamine.—M. Silva.—The substance obtained by this author, by means of a complicated process, is a liquid exhibiting a strongly ammoniacal smell; very alkaline, inflammable, precipitating solutions of alumina, and re-dissolving the precipitate thus formed; also precipitating solutions of salts of magnesia, nickel, cobalt, and iron; boiling point about 50°; vapour density referred to air, 2·01; specific gravity at 0°, 0·7283; formula—

$$\left.\begin{matrix}(CH_3\text{--}CH_2\text{--}CH_2)\\ H\\ H\end{matrix}\right\} N.$$

In 100 parts:—C, 61·01; H, 15·26; N, 23·73. The author has studied some of the salts this basis forms.

Constitution of Pseudotoluidine.—M. Koerner.—The author discusses in this paper the correctness or incorrectness of certain results published on this subject by M. Rosenstiehl. The paper is full of formulæ and not well suited for abstraction.

Testing the Antiquity of Manuscripts by means of Studying the Age of the Ink Employed in Writing it.—M. Gaultier de Claubry.—The chief result the author points to is that M. Carré's method alluded to by us in a former number of an abstract of this periodical, is entirely unfit to be used as a test for indicating the age of any writing.

Synthesis of Crotonic Aldehyde.—MM. Paterno and Amato.—The authors have tried, but in vain, to prepare this aldehyde by heating, in sealed tubes, aldehyde and chloride of ethyliden. The reason that they publish this, as they themselves confess, very imperfect work, is due to the publishing of the results of experiments on this subject by M. Kekulé.

Preservation of Stone from the Ravages of Cryptogamic Plants by means of the Oxide or Salts of Copper.—M. Robert.—The gist of this paper is, that the pedestals upon which are placed statues made of bronze, or to which copper ornaments are added, are protected by the salts of copper which are gradually formed under the influence of wind and weather; and these salts, being washed down by rain, prevent, by their poisonous action, the formation of small cryptogamic plants, and hence, also, prevent the decay and deterioration of the stone. The author thinks that salts of copper, or copper or bronze ornaments, might be applied successfully to pedestals, as well as buildings, in order to preserve the stone they are made of from decay, the chief cause of which is, according to the author, the growth of minute cryptogamic plants.

We learn from this number that, on the 8th of April last, the Imperial Academy of Sciences of St. Petersburg appointed a committee with a view of propounding measures to be taken in order to submit to an international committee several questions relating to the making of standard weights and measures according to the decimal system. The report of that Russian committee was read at this meeting of the French Academy, and gave rise to a lengthy discussion. The chief

points of the Russian report may be briefly stated as follows:—That steps be taken by the Academy of St. Petersburg to induce the Russian Government to use its influence to invite a meeting of delegates of all foreign states, in order to discuss and regulate everything requisite to the proper manufacture of standard weights and measures according to the decimal system; the place of meeting to be afterwards designated; and that M. Jacobi be requested to bring this matter before the meeting of the British Association for the Advancement of Science, at Exeter, and be also requested to urge the necessity of the general adoption of the metrical system by all men of science in all countries.

Bulletin de la Société Chimique de Paris, August, 1869.

From the abstracts of the *procès verbaux* of the meetings of this Society, held on the 4th and 18th of June last, and published with this number, we learn that M. Longuinine spoke about his—

Researches on Birch-Wood Tar.—When this tar is distilled along with water, there is obtained a light, yellowish-coloured oil, which, on being treated with caustic potassa, yields a crystalline compound, due to a peculiar phenol, which constitutes about 1-15th of the entire quantity of oil obtained. The remainder of this oil yields chiefly tereben, boiling and distilling over between 160° and 180°. The phenol obtained exhales the peculiar and well-known smell of Russian leather, chiefly employed for bookbinding purposes.

M. Friedel spoke on the—

Formation of the Chlorides of Acids. — Anhydrous phosphoric acid does not, at 0°, act upon crystallised acetic acid; when this mixture is treated with dry hydrochloric acid gas, chloride of acetyl is formed.

M. Joffre communicated the composition of a native crystalline carbonate of soda found in Fezzan (a great oasis in Tripoli, Africa); this salt is a sesquicarbonate, $2NaO,3CO_2+4HO$.

M. Thiercelin called attention to the formation of the saltpetre beds on the coast of Peru, and states that the beds situated close to sources of water impregnated with common salt are yet quite free from iodine.

M. Bouchardat said that, according to his experiments, cinchonine fuses at from 256° to 262°. Kept at an elevated temperature in a current of carbonic acid, this base begins to volatilise, without decomposition, at 275°; when, however, cinchonine is kept for a length of time at 150°, it is converted into liquid volatile bases.

This number contains the following original papers:—

Synthesis of a New Butylen, Ethyl-Vinyl.—M. Wurtz.—The author mixes zinc-ethyl and bromide of ethylen, heats in a sealed tube up to 140° for some hours, and next leaves the tubes quietly standing for several weeks. Previous to opening the tubes, they are placed in a strongly-cooling mixture, and arrangements made to collect the gas which may escape on opening the tubes into bromine. After proper purification, the bromide obtained constitutes a perfectly colourless liquid boiling at about 166°; sp. gr. at 0°, 1·876. The ethyl-vinyl obtained from this bromide boils at 5°; and, on being re-converted again into a bromide, that latter compound boils again at 166°.

Synthesis of Aromatic Acids. — M. Wurtz. — The method described by the author consists in treating an organic chloride or bromide with chloroxycarbonic ether and sodium-amalgam. In this way, the chlorine or bromine seized upon by the sodium-amalgam is replaced by $CO_2(C_2H_5)$. The author has applied this method in some instances, and thus prepared benzoic ether according to the following formulæ;—

$$C_6H_5Br + CO\left\{\begin{matrix}O,C_2H_5\\Cl\end{matrix}\right. + Na^2 = NaCl + NaBr + C_6H_5,CO_2(C_2H_5).$$

Bromide of ethyl. Chloroxycarbonic ether. Benzoic ether.

Researches on the Propylic Alcohol of Fermentation.—Dr. G. Chaucel.—This lengthy and very concisely written paper, full of formulæ, does not admit of suitable abstraction.

Ethylic Series of Silicium.—MM. Fricdel and Ladenburg.—The authors describe in this paper, at great length, their experiments to obtain compounds wherein silicium replaces one or more atoms of carbon. Silicium-ethyl, $Si(C_2H_5)_4$, is a liquid boiling at from 150° to 154°. Silicium-hexethyl, $Si_2(C_2H_5)_6$, is also a liquid, readily inflammable, and giving off, while burning, fumes of silica; vapour density, 7·96.

On Acetochlorhydrine and Octylglycol. — M. de Clermont.—Acetochlorhydrine of octylen is a liquid, insoluble in water, soluble in alcohol, ether, and acetic acid; rather readily inflammable, and burning with green-bordered flame; boiling point, 225°; sp. gr. at 0°, 1·026. Composition, in 100 parts:—C, 58·11; H, 9·20; Cl, 17·19.

Some New Ferrocyanides and Ferricyanides. —M. Wyrouboff.—This paper is chiefly a critical review of the labours of M. Riendel published in a German periodical some years ago. This author's paper is too lengthy, and too much filled with a large number of formulæ, to admit of useful abstraction.

Analysis of a Native Carbonate of Soda.—M. Joffre, —Composition, in 100 parts:—Soda, 39·41; carbonic acid, 39·58; water, 19·52; sand, 0·53: oxide of iron, 0·01; carbonate of lime, 0·05; chloride of sodium, 0·46; sulphate of soda 0·44. This salt, therefore, belongs to the mineralogical species known as urao.

Action of Hydrogen upon Acetylen when Platinum Black is simultaneously present. — M. de Wilde.—The author finds that, when acetylen and hydrogen, both chemically pure, are brought together, at the ordinary temperature, in a space wherein platinum-black is placed, hydride of ethyl is formed—

$$C_2H_2 + 2H_2 = C_2H_6.$$
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When less hydrogen is applied, it appears, says the author, that ethylen is formed.

Acetic Derivatives from Mannite.—M. Grange.—This paper and the following—

Acetic Derivatives obtained from Amylum Gum and the Hydrocarbonates (MM. Schutzenberger and Naudin), have been already briefly abstracted from the *Comptes Rendus*, a remark which equally applies to—

Butyrate and Valerate of Isopropyl (M. Silva) and—

New Sulphur Acid.—M. Schutzenberger.

Researches on the Ethers of Phenol.—M. Lipmann. —Ethylendiphenol, obtained by the author by a complicated series of operations, is, when pure, a solid substance, fusing at 95°, insoluble in water, readily soluble in chloroform, and also in boiling alchol; formula—

$$\left.\begin{matrix}(C_6H_5)_2\\C_2H_4\end{matrix}\right\}O_2.$$

Ethylen-diphenol sulphuric acid; the lead- and barium-salt of this acid have been studied, the former has the following formula:—

$$\left.\begin{matrix}(C_6H_4SO_3)_2Pb''\\C_2H_4\end{matrix}\right\}O_2.$$

Tetrabromide of ethylen-diphenol is a solid substance, crystallising in small needles, fusible at a little above 100°. The real constitution of ethylen-diphenyl is, according to this author—

$$C_6H_5CH_2.C_6H_5CH_2.$$

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 12, 1869.

This number contains the report of the meeting of this Society, held under the presidency of Dr. A. W. Hofmann, on

the 28th of June last. From the *procès verbal*, we learn that a committee has been formed for the purpose of erecting a simple, yet appropriate, memorial tombstone on the grave of the late Dr. F. F. Runge, who died at Oranienburg, near Berlin, on the 25th of March, 1867. The deceased was well and deservedly known, and well deserved from science and industry this posthumous memorial of services rendered.

The following papers were read:—

Chlorides of Carbon.—M. H. Kolbe.—Through the kindness of Dr. Marquart, the celebrated practical and operative chemist, and owner of chemical works at Bonn, the author has obtained a large quantity of the solid sesquichloride of carbon, C_2Cl_6. (To some of our readers the fact may be of interest to learn that this preparation has been used with comparative success in the worst forms of Asiatic cholera). This substance is readily converted into the fluid chloride of carbon, C_2Cl_4, by means of the action of zinc and sulphuric acid, although there is simultaneously formed a compfound, C_2HCl_3. Since the compound C_2Cl_4 enjoys the property of combining directly with chlorine and bromine, the author thought it might be possible to make that compound enter directly into combination with two atoms of hyponitric acid. This nitro compound, $C_2Cl_4(NO_2)_2$, is prepared when the simple chloride of carbon, C_2Cl_4, is mixed with hyponitric acid, kept very cold by means of cooling mixture, and next heated in a sealed tube at from 110° to 120°. The quantity of dinitro-perchloride of ethylen, or dinitro-chloride of carbon, thus obtained is rather small in quantity since, during the preparation, a mass of by-products are formed, among which is chlorocarbonic oxide. The substance alluded to is a solid volatile body, soluble in alcohol and ether, insoluble in water, crystallises like the sesquichloride of carbon, and, like that substance, cannot be reduced to powder. This compound cannot be fused without decomposition. The elementary analysis gave results leading to the formula $C_2Cl_4(NO_2)_2$.

Compound of Ethylen and Nitric Acid.—M. Kekulé.—The author has caused pure nitric acid, and, next, a mixture of nitric and sulphuric acids, to act upon ethylen. In the first instance, a large portion of the ethylen is destroyed by oxidation; but, with great care, and the application of strongly-cooling mixtures, an oily fluid was obtained, on addition of water in small quantity. Large quantities of this oil were obtained when ethylen was made to pass through a mixture of nitric and sulphuric acids, kept cold by means of very cold water. The substance obtained is, after purification, a colourless oily liquid of 1·472 sp. gr.; its vapour attacks the eyes, and causes headache; it is not volatile with decomposition. Far below its boiling point this substance is decomposed, giving off red vapours; even when water is present, the distillation is impossible without the simultaneous formation of nitrous acid, deutoxide of nitrogen, oxalic acid, glycolic acid, and some glyoxylic acid. The same decomposition takes place when this compound is boiled with solutions of alkalies. The author assigns to this body the empirical formula, $C_2H_4N_2O_5$, but he considers it to be an ether of glycol—

$$\left.\begin{matrix} NO \\ \| \\ C_2H_4 \\ NO_2 \end{matrix}\right\}O$$

Phenol-Sulphuric Acid and Nitro-Phenol-Sulphuric Acid.—M. Kekulé.—The author observes that he was the first who pointed out the fact that, when phenol and sulphuric acid act upon each other, there are formed two isomeric sulpho acids, para-phenol-sulphuric acid and meta-phenol-sulphuric acid. Since there have been different experimenters on this subject, some of whom have altogether overlooked this meta acid, and since the author has found that, with different modes of preparation the quantity obtained of this acid varies greatly, he instituted some experiments to ascertain under what conditions either of the two isomeric modifications are chiefly formed. The result obtained is that, when a mixture of phenol and sulphuric acid is left quietly standing at the ordinary temperature, it contains, not only at first, but for weeks after, chiefly the meta acid. When the mixture is heated, the quantity of the para acid increases, and continues to do so until, when the temperature is for some time kept at from 100° to 110°, the para acid only is present in the mixture. When the meta acid, obtained in pure state from its salts, is heated for some time on a water-bath, it is thereby entirely converted into the para acid. As regards the nitro-phenol-sulpho acid, the author found that there does not exist any doubt that, by whatever method this acid is prepared, the product obtained is always identically the same.

Artificial Alizarine.—MM. Graebe and Liebermann.—The authors say the publishing of their French patent on this subject makes it necessary not to delay any further the completion of their brief paper read before this Society, on the 11th of January, on the preparation of alizarine from anthracen. The authors, at the same time, state that, since they reserve their right of publishing full details of experiments and analysis on this topic, they only read a brief, rough, outline sketch. They succeeded in reducing alizarine obtained from madder to anthracen; and, suspecting that alizarine is a chinon acid, the idea of obtaining alizarine artificially became a feasible matter, as may be learned from the following formulæ:—

$$\underset{\text{Anthracen.}}{C_{14}H_{10}.} \qquad \underset{\text{Alizarine.}}{C_{14}H_6\left\{\begin{matrix}(O_2)'' \\ (OH)_2\end{matrix}\right.}.$$

The affair rested upon the possibility of substituting in anthracen, for two atoms of hydrogen, the group $(O_2)''$, characterising the chinons; and, for two other atoms of hydrogen, two atoms of hydroxyl. Prof. Anderson, of Glasgow University, discovered that, when anthracen is treated with nitric acid, oxanthracen is formed; this is, according to the authors, the chinon of anthracen, (anthrachinon, $C_{14}H_8(O_2)''$). This substance is also obtained from anthracen, by means of other oxidising agents, as, for instance. bichromate of potassa, and sulphuric or acetic acids. The authors tried to introduce into this anthrachinon two atoms of bromine or chlorine, in order to be able, by this means, to obtain the two atoms of the hydroxyl group, which are wanted. Chlorine does not act readily upon anthrachinon; with bromine, the substitution ensues at 100°. When, therefore, anthrachinon is heated for several hours in sealed tubes placed in a water-bath, after addition of four atoms of bromine, it is converted into bibrom-anthrachinon, while hydrobromic acid is simultaneously formed—

$$C_{14}H_8(O_2)''+4Br=C_{14}H_6Br_2(O_2)''+2BrH.$$

This body is a solid substance, soluble in benzol, crystallising from that solution, or by sublimation, and exhibiting bright yellow-coloured needle-shaped crystals. On being heated with a thoroughly concentrated solution of caustic potassa to about 170° (at which temperature the reaction sets in), the mixture assumes a deep blue colour, and the mass becomes soluble in water, exhibiting thereby the well-known and beautifully violet colour of alizarinate of potassa; when an acid is added to this solution, alizarine is precipitated from it, in the shape of a reddish brown flocculent matter. The following formula exhibits the formation of alizarinate of potassa from bibromide of anthrachinon:—

$$C_{14}H_6Br(O_2)''+4KHO=C_{14}H_6(OK)_2(O_2)''+2KBr+2H_2O.$$

The authors next state that they discovered another method for the preparation of bibromide of anthrachinon, and its conversion into alizarine. Since the bibromide of anthracen is converted, by means of being heated along with nitric acid, into anthrachinon, according to this formula:—

$$C_{14}H_8Br_2+2NHO_3=C_{14}H_8(O_2)''+2Br+2NHO_2,$$

the authors suspected that tetrabromanthracen, $C_{14}H_6Br_4$, would be readily converted into bibromide of anthrachinon by the same means. On trying this experimentally, they found that their opinion proved correct. By treating the bibromide of anthrachinon thus obtained with a strong solution of caustic potassa, alizarine was again obtained. The authors positively state that the artificial alizarine thus ob-

tained is in every respect identical with that obtained from madder; this is, be it observed, the first instance of the preparation of a naturally-occurring vegetable colouring matter by artificial means.

Behaviour of the Salts of Silver towards Iodine.—M. Weltzein.—After referring to experiments made by himself in 1854 and 1860, on this subject, the author states: —(1) When iodine acts upon the nitrate of silver, no free oxygen is given off; (2) that, not the anhydride of nitric acid, but hyponitric acid, is obtained, the reaction being represented by—

$$3AgNO_3 + 3I = 3NO_2 + AgIO_3 + 2AgI.$$

The author further says that he hoped to obtain, by the action of iodine upon the acetate and benzoate of silver, the respective anhydrous acids, but failed, and next winds up his paper with a long series of formulæ, not deduced from his own experiments, but made up from theoretical reasoning. The formulæ are too complicated and lengthy to be quoted.

There follows in this number, under the title of Correspondence, letters written from London, from Zürich (Switzerland), and from Cambridge, U.S. M. Meister, secretary of the Chemische Harmonika, a chemical society established at Zürich, writes—"At our meeting on the 22nd of June last, MM. Merz and Weith communicated that, when powdered sulphur is strewed on the surface of boiling aniline, a strong evolution of sulphuretted hydrogen gas is observed, while a base containing sulphur is thereby formed. Other organic substances, as, for instance, acetanilide, glycerine, and naphthaline, are acted upon by sulphur in the same way at a higher temperature. When pure and dry hydrogen gas is made to pass through boiling sulphur, sulphuretted hydrogen gas is developed in large quantities."—Mr. W. Gibbs writes from Cambridge, U.S., communicating the results of some experiments made by him on the—

Action of Nitrites of Alkalies upon Uric Acid and Derivatives therefrom.—When uric acid is heated along with a solution of nitrite of potassa or soda, and sulphuric acid, a strong effervescence takes place, the uric acid is completely dissolved, and the fluid contains alloxan and alloxantin. On evaporation to dryness on a water-bath, parabanic acid is obtained, and very small quantities of two peculiar substances—one a red-coloured, the other a bright bluish fluorescent—both flocculent substances. When acetic acid is applied, instead of a mineral acid, the same phenomena are observed to take place; but the filtered solution deposits a very voluminous salt, which, if nitrite of potassa were applied to the experiment, is composed according to the formula $C_4H_2KN_5O_2$. The peculiar acid contained in this salt has been named stryphninic acid, from στρυφνος, bitter astringent, since the acid and its salts exhibit this taste. The formula of the free acid is $C_4H_3N_5O_2$; it appears to be monobasic, and all its salts, except the lead-salt, are soluble in water. The author read this paper, of which only a brief account is here given, before the National Academy of Sciences, the transactions of which are, we believe, regularly published.

Existence of Molecular Compounds in Gaseous State.—M. A. Naumann.—This paper, which is placed under the section of *Mittheilungen*, and is dated from Giessen, the 1st of July last, is a philosophical essay, and not well suited for abstraction.

We beg to remind our readers that during the months of August and September this periodical is not published.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 199, July, 1869.

The only paper relating to chemistry in this number is on the—

Use of Extracts of Madder in Calico Printing, and the Part each of the Different Pigments contained in Madder Plays in this Operation.—M. Schutzenberger.—The author begins by stating that, notwithstanding the discovery of aniline and other artificially-made colours (dyes), madder and its preparation yet occupy a first rank among dyes, and not only will continue to do so, but its use will become more extended. The author next reviews, at some length, the history of madder, and preparations obtained from it, during the last forty years, alluding to garancine, flowers, or bloom of madder, and commercial alizarine—that is to say, madder submitted to high pressure steam. To M. Kopp is due the discovery of preparing, on the large scale, the pure colouring matter from madder, and, also, of getting purpurine separately therefrom; this substance is very little used, but the alizarine (the chief tinctorial matter contained in madder) is largely used. At Cosmarros, a town in Bohemia, and at Thann, France, the direct application of alizarine, without the use of mordants, has been most successfully applied, especially in the last-named town, by M. Scheurer. The author enters into some purely technical details on this subject, which, however interesting, we leave out, following him rather to the more purely chemical part of his paper. Madder contains:—(1). Alizarine, $C_{20}H_{12}O_6$, a solid substance, readily crystallising, forming orange-coloured needle-shaped crystals by sublimation by heat, soluble in benzol, also in warm alcohol, yielding, with alkalies, a bluish purple-coloured solution. (2). Purpurine, $C_{20}H_{12}O_7$, a solid substance exhibiting red-coloured, needle-shaped crystals, when crystallised from alcohol, or, also, by sublimation by heat; but by this latter process, a large portion of the substance is decomposed; soluble in benzol, also in warm alcohol, and yields with alkalies, red coloured solutions. (3) Pseudo-purpurine, $C_{20}H_{12}O_9$, a solid substance, exhibiting, when crystallised from its solution in benzol, small brick red-coloured needle-shaped crystals; is decomposed by heat, yielding purpurine; soluble in benzol, very slightly soluble in alcohol, even at boiling point, and yields, with alkalies, a red coloured solution. (4). An orange-coloured matter, $C_{20}H_{12}O_7 + 2H_2O$, a solid substance, exhibiting, when obtained by the slow evaporation of its alcoholic solution, a crystalline conglomerated mass; is decomposed by heat, yielding purpurine; insoluble in benzol, very soluble in alcohol, and does not yield a solution with alkalies. (5). Purpuro-xanthine, $C_{20}H_{12}O_6$ (?), a solid substance, yielding, either by sublimation, or by evaporation of its solutions in alcohol or benzol, yellow-coloured needle-shaped crystals; sublimes by heat; readily soluble in benzol, as well as in alcohol; and yields, with alkalies, a yellow-coloured solution. As regards the formulæ here quoted, the author desires it to be understood that they represent exactly the percentical composition, but that, in a scientific point of view, these formulæ do not express the constitution of the substances; moreover, C=12; H=1; and O=16 in this case. Each of these five substances is fit for use as a dyeing material; but alizarine alone is the dye *par excellence*. It appears, says the author, that the solidity (the fastness or goodness) of the different tints of colours produced by these dyes varies in the inverse ratio of the quantity of oxygen contained in the substance in excess of the hydrogen. Where the quantity of oxygen increases, we come from a more violet red to a bright red, and at last to brick red; and from bright violet colour to a more dirty violet, and, next, to greyish violet. Science has to elucidate practice in many points in respect of madder. No doubt a thorough study of this subject will enable us to find the key to the best mode of so mixing the different bodies to be described, as to produce pigments precisely suited to each peculiar shade of colour required.

Quantity of Copper Produced in the Year 1866 over the Whole World.—M. Petitgand.—The quantity of this metal raised on the entire globe, in the year alluded to, the latest period that statistical records of this kind have been reliably brought together, amounts to 93,415 tons, which is nearly double the quantity raised in 1846. From the statements made by this author, there appears to be an increasing tendency to a lower cost price of this metal. Large and valuable deposits of excellent copper ore known to exist, especially in Polynesia, are as yet untouched.

Moniteur Scientifique, No. 304, August 15, 1869.

This number contains the following original papers and communications:—

Limit of Magnetisation of Iron and Steel.—M. Waltenhofen.—The result of the author's researches on this subject are, that the magnetic moment of the unit of weight of iron may attain a certain limit which is constant and independent of the form and dimensions of the electro-magnet. The absolute value is about 2100 absolute units, expressed in milligrammes. The limit of magnetisation which soft iron can temporarily attain is about five times greater than the permanent magnetism obtained with steel bars, which rarely exceeds 400 units to the milligramme.

Mercury Mines of Almaden.—M. Jouglet.—From this lengthy paper, we learn that mercury, as metal, has been known from the most remote antiquity—that there have been mines worked for mercury ore in Asia Minor in the time of Xenophon; the mines of Almaden, Spain is yet the largest source of mercury for Europe. The cost of 100 kilos. of the ore is, everything included, only 16 francs and 10 centimes; but it yields, as this author says, by unsuitable management, only 6·9 per cent of mercury, 100 kilos. of which cost, on the spot, 141 francs and 30 centimes; but at Sevilla the price is already 177 francs and 80 centimes, in consequence of cost of transport and the iron vessels in which the metal is carried. The average quantity of mercury produced annually amounts to about 15½ tons, by weight.

Poisoning Caused by Green Tarlatan.—M. Bobierre.—The author says that he obtained from Nantes a sample of this kind of tissue, which, on being tested, was found to contain 10·3 grms. of Schweinfürt green (arsenite of copper) to the square metre, equivalent to 6·03 grms. of arsenious acid. The full dress made of this tissue contained, by weight, no less than 391·4 grms. of arsenite of copper, equivalent to 229 grms. of arsenious acid. At even every slight shaking of the tissue, clouds of a greenish dust came off, which readily explain the poisoning of the party who made the dress. The author tested—1st, by treating the tissue with an alkaline lye, passing chlorine through the solution and converting the arsenic acid into ammonio-arsenite of magnesia; 2nd, by estimating the quantity of black oxide of copper left after burning the tissue in a red-hot muffle.

Comptes Rendus des Séances de l'Académie des Sciences, August 30, 1869.

This number contains the following original papers bearing upon, or more or less relating to, chemistry and allied sciences:—

Antidote of Nicotine.—M. Armand.—The author proposes that the deleterious effects of the use of tobacco should be counteracted, if not entirely annihilated, by moistening tobacco, while undergoing the various preparations and fermentations, previous to its delivery to the consumer, with a strong infusion, or other preparation, of water-cresses, since the author has discovered that this vegetable contains principles which, without destroying the peculiar aroma of tobacco, destroy the deleterious effects of nicotine.

Action of Hydrate of Potassa upon the Sulphuretted Derivatives of the Carbides of Hydrogen.—M. Berthelot.—The author has studied the action of fusing caustic potassa upon the sulphuretted derivatives of some hydrocarbons which are not decomposed by water or alkalies at 100°. The soda-salt of hydrethylosulphuric acid, $C_4H_6S_2O_6$, is readily decomposed, and the result is the formation of pure ethylen and an alkaline sulphite—

$$C_4H_5NaS_2O_6+KHO_2=C_4H_4+H_2O_2+S_2KNaO_6.$$

Formenosulphate of soda, $C_2H_3NaS_2O_6$, should, by analogy, have yielded methylen, C_2H_2; but an excess of potassa decomposes the formenosulphate of soda, yielding hydrogen and carbonate and sulphite of alkalies—

$$C_2H_3NaS_2O_6+3KHO_2=C_2K_2O_6+S_2KNaO_6+3H.$$

With a relatively small quantity of potassa, a very volatile methylsulphide is formed, which, in many respects, is like methylic mercaptan. The author has extended his researches over a large number of equally complex compounds as those already alluded to; but, to be well understood, it would be required to quote a very large number of complicated formulæ; we therefore refrain from further abstraction of this paper.

Synthesis of Acetic Acid from Acetylen by a New Method.—M. Berthelot.—After referring to a now well-known method for the conversion of acetylen into acetic acid, devised by this author some time ago, the author now communicates another, and easier method—to wit, the heating of protochloride of acetylen, either with aqueous potassa solution up to 230° or heating with an alcoholic solution of potassa up to 100°, for about ten hours. When the perchloride of acetylen is heated with an alcoholic solution of potassa up to 100°, glycolic acid is formed; and when the same perchloride is heated with aqueous potassa up to 230°, oxalic acid is formed.

September 6, 1869.

This number opens with a report on the practice of—

Heating Wines in order to Improve and make the same Keep Better.—M. Pasteur.—The contents of this paper are only interesting to wine growers. It appears, however, that the cautious heating of wine (on the large scale, and before it has reached maturity) not only improves its quality, but has the effect of making it keep better, and render fit for transport on long journeys, and by sea, such brands of French wines as are otherwise not suitable, on account of their rapid deterioration.

Detailed Account of the Spectrum of the Sun's Spots.—Rev. Father A. Secchi, S.J.—This indefatigable *savant* gives in this paper a very precise and fully detailed description of this difficult subject, which, however, since it is treated in a strictly astronomical style, we do not further allude to.

Nature of Aniline Green.—MM. A. W. Hofmann and Ch. Girard.—The authors treat, in this memoir, the following subjects:—*What is iodine green?* is a question first answered by stating that it is a secondary product, which is formed during the manufacture of the colouring matters generated by the methylation and ethylation of rosaniline, and known in commerce as Hofmann's violets. The preparation of iodine green (more correctly, green produced by iodine) is next treated at length; the preparation of this substance in crystallised state is then fully described. The composition of this green is—

$$C_{25}H_{33}N_3OI_2=\left\{\begin{matrix}H_{16}\\C_{20}(CH_3)_3\end{matrix}\right\}N_3\left\{\begin{matrix}CH_3I\\CH_3I'\end{matrix}\right\}H_2O.$$

This memoir is a very lengthy and exhaustive monograph on this subject not well suited for further condensation.

Thermochemical Researches on the Substances formed by Double Decomposition.—MM. Berthelot and Longuinine.—This memoir, divided into several chapters, is too much filled with a very large number of figures, without which this paper cannot be well understood, and, therefore, we regret that we can only here quote the title of a highly scientific memoir wherein the authors have laid down the results of a long series of carefully-made experiments.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 200, August, 1869.

Leaving the papers relating to mechanics, steam engineering, and watchmaking, met with in this number, we notice the conclusion of a very lengthy, yet very excellent, monograph on—

Truffles.—M. Chatin.—The chemical composition of these cryptogamic vegetables has been investigated at even so early a period of the infancy of chemical analysis as the year 1803, and at various epochs after that year, such investigations have been especially conducted in France. The latest

researches on this subject have been recently made, and are quoted by the author, as well as the analysis made by M. Payen. From these we learn that the *Agaricus campestris*, the edible mushroom, contains, in 100 parts:—Water, 91·010; nitrogenous matter and traces of sulphur, 4·680; fatty matter, 0·396; cellulose, dextrin, sugar, and mannite, 3·456; saline matter, 0·458, among which there is a very large proportion of phosphoric acid. Genuine truffles contain 76·60 per cent. of water and 23·40 per cent. of solid matter, including 7·16 per cent. of nitrogen; upon 100 parts, the ash of truffles contains 27·40 phosphoric acid, and 28·34 potassa; the quantity of phosphoric acid contained in the ash of truffles growing in the neighbourhood of Nérac amounts to 33·5 per cent. This paper contains valuable information on the cultivation of truffles, on the bibliography of this subject, and on the commercial importance of a vegetable which, at first sight, one would hardly credit to yield, to fifty departments of France, a sum of nearly 16,000,000 francs yearly. The author states that these vegetables are highly nutritious, and that, when taken at meals in lieu of butcher's meat, they are readily enough digested, provided they are properly cooked, for which purpose the author gives the necessary directions.

Estimation of the Quantity of Non-Saponified Fatty Matter contained in Soap.—Dr. Bolley.—Dry the soap at 100°, in order to eliminate, as much as possible, any water it contains. Treat the soap, after having been previously reduced to thin shavings, or powder, if possible, with rectified benzol, or petroleum naphtha. Boil the soap for several hours with this fluid placed in a retort, and take care to pour back into that vessel any of the hydrocarbon which distils over. Next filter the liquid, and evaporate on a water-bath. 11·3 grms. of Marseilles soap (this is made with inferior kinds of olive oil and soda) treated in this manner left a residue, on evaporation, weighing 0·145 grm., or 1·2 per cent.; this quantity consisted of the non-saponified fatty matter, and a very small quantity of soap which had been dissolved. On igniting the residue just mentioned, it left 0·002 grm. of ash, equal to 0·13 per cent. of the soap submitted to analysis.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 6, 1869.

This number contains the following original papers relating to chemistry:—

Researches concerning the Isomerism of the Salicylic Series.—M. Henry.—The chief object of this lengthy memoir is the study of the action of pentabromide of phosphorus upon a number of salicylic compounds. Considering the existing analogy between pentachloride and pentabromide of phosphorus, the conclusion seemed justifiable that these two bodies would act in the same manner upon aldehyde and salicylic acid. The author's researches have proved that, instead of this supposition being correct, the pentabromide behaves as if it were free bromide, giving rise to the generation of bromated organic compounds only.

Researches concerning the Ethereal Derivatives of the Acids and Polyatomic Alcohols.—M. Henry.—The author gives a review of his experiments on the chloride of ethylglycollyl, obtained by the action of terchloride of phosphorus upon ethylglycollic acid. The author's aim was to apply that chloride, in order to produce several diglycollic combinations which would have been interesting for the elucidation of isomerism in general; this aim has not, however, been attained by the author at present.

Researches on the Derivatives of Phenyl-Acetic (a Toluic) Acid.—Dr. Radziszewski.—This memoir, like the two foregoing, of which the headings were mentioned, does not admit of suitable abstraction. This second portion of a monograph on this subject is divided into nine separate sections, and contains a complete and exhaustive review of a lengthy series of complex compounds derived from phenyl-acetic acid, $C_6H_5—CH_2—CO(OH)$.

The American Journal of Science and Arts, July, 1869.

This number contains the following original papers:—

Charles Grafton Page.—A biography of this deceased philosopher, who has been, for a series of years, one of the foremost scientific investigators of the Union.

Hortonolite, a New Member of the Chrysolite Group.—Messrs. Brush and Blake.—The mineral alluded to has a dark yellowish green colour on the fresh fracture, and a vitreous to resinous lustre; hardness, 6·5; sp. gr., 3·91. Before the blowpipe in the closed tube no change takes place; in the open tube, and on charcoal, the mineral becomes dull and magnetic, and fuses in the platinum forceps; with borax and salt of phosphorus it yields the reaction for iron and silicic acid, and with soda for manganese. The pulverised mineral forms, with hydrochloric acid, a gelatinous mass, and is almost completely decomposed. Average composition, in 100 parts:—Silica, 33·59; protoxide of iron, 44·37; protoxide of manganese, 4·35; magnesia, 16·68; lime, a trace; potash, 0·39; loss on ignition, 0·29. A spectroscopic examination of the concentrated chlorhydric solution showed sodium, potassium, and calcium lines only.

Effect of Atmospheric Air, when Mixed with Gas, in Reducing its Illuminating Power.—Messrs. B. Silliman and A. Wurtz.—The results arrived at by the authors may be summarised as follows:—For any quantity of air less than 5 per cent., mixed with gas, the loss in candle power due to the addition of each 1 per cent. is a little over 6-10ths of a candle (0·611 exactly); above that quantity, the ratio of loss falls to half-candle power for each additional 1 per cent. up to about 12 per cent. of air; above which, up to 25 per cent., the loss in illuminating power is nearly 4-10ths of a candle for each 1 per cent. of air added to the gas. With less than one-fourth of atmospheric air, not quite 15 per cent. of the total illuminating power remains, and with between 30 and 40 per cent. it totally disappears.

Formation of Sugar in the Liver.—Dr. Barker.—A physiologico-chemical essay.

Aurora at Toronto, Canada.—Mr. Kingston.

Qualitative Separation of Cobalt and Nickel.—Mr. F. W. Clarke.—As is well known, ferricyanide of potassium precipitates cobalt and nickel from their solutions. The cobalt precipitate is of a deep reddish brown colour, while the nickel compound is of a dirty yellowish brown. The nickel ferricyanide is readily soluble in ammonia and in solution of cyanide of potassium, while the corresponding cobalt compound is absolutely insoluble in either. It is a noteworthy fact that the previous presence of either ammonia or potassium-cyanide entirely prevents the precipitation of cobalt by the ferricyanide; the solution, when ammonia is present, merely assuming an intense blood-red colour. It is always best to employ ammonia to dissolve the nickel precipitate, since the presence of a cyanide renders the subsequent detection of that metal rather difficult. The author proceeds, as follows, in an analysis:—To the slightly acid solution containing the two metals, first an excess of chloride of ammonium is added; this causes the cobalt precipitate, which otherwise would run through the filter, to fall in a denser state, and also of much darker colour, often nearly black. The ferricyanide of potassium is then added, until the precipitation is complete, and afterwards strongly agitate with a considerable excess of ammonia. Upon filtering, all the cobalt remains upon the filter, being recognised by the characteristic colour of the precipitate, and the nickel is readily detected in the filtrate by means of ammonium-sulphide. This process is merely offered, the author states, as a convenient means of detecting cobalt and nickel in presence of each other in ordinary analyses.

Wollongongite, a remarkable Hydrocarbon found in the Wollongong District of the Illawarra Coal Field, N. S. Wales.—Mr. Silliman.—This remarkable substance occurs five miles inland, and forty miles south of Sydney, in cubical blocks, without lamination, extremely

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tough, and resounding like hard wood under the blows of the hammer. Hardness, 2·5; sp. gr., 1·04 to 1·49; lustre, resinous; colour, greenish black and brownish black; tasteless; insoluble in alcohol, ether, or benzol; slightly soluble in sulphide of carbon; heated in a test-tube, it does not melt, decrepitates and distils a copious flow of oil of a yellow colour and heavy odour, giving off much gas; it is readily kindled, in thin splints, by a match, burning with a brilliant flame and much smoke. Analysis in platinum crucible yields:—Volatile matter, 82 5 per cent.; fixed carbon, 6·5 per cent.; ash, 11·00 per cent.

Estimation of Carbonic Acid.—Mr. S. W. Johnson.—Since the woodcut added to this paper is absolutely required for it to be clearly understood, we do not abstract it here.

Journal für Gasbeleuchtung, July, 1869.

We notice from this number the following papers and communications of more general interest:—

Effect of Illuminating Gas upon Vegetation.—Dr. Poselger.—The author of this paper deserves the thanks of a great public for his energy in determining, by positive experiments, that the death of fine trees growing along the streets and promenades of many, especially continental, towns, is not due, as has been too often asserted, to the effects of leakage in gas mains. From the author's experiments, made with trees and shrubs, it is a settled point that no damage can accrue to the trees, nor their growth interfered with, by any quantity of gas which may escape in the soil and find its way to their roots. Moreover, the author points out that no care is taken at all with the trees, as regards keeping the soil covering the roots, so as to admit of air permeating freely; that too often that soil becomes as hard as rock; and that, in very many cases, the filthy habit of using trees, especially if so thick as to admit of a man hiding behind it, instead of urinals, contributes largely to the destruction of fine old trees. The leakage of gas, or the laying down of mains near the roots, has nothing to do with this destruction; other causes influence the decay of trees, but with these we do not further occupy ourselves.

Brief Abstracts from the Reports of the Meeting of German Gas Engineers and Gas-Works' Managers held at Coburg at the end of May.—*Analysis of Oberurseler Oxide of Iron.*—This material is applied for the purification of gas, and was found to consist principally of 36 5 per cent. of a siliceous sand, 38 per cent. of Fe_2O_3, and 11·7 per cent. of Mn_2O_3. The material known as Mannheim oxide of iron contains 98 per cent. of Fe_2O_3, and small quantities of lime and sand. *Report of the Committee on Photometry.*—This paper contains a description of a series of experiments made at Frankfort-on-the-Maine, with the view to enable the gas-works' managers throughout Germany and some adjoining countries to adopt a general plan of making photometrical tests of the gas they manufacture. From this report, we learn that the use of glycerine, instead of water, in wet gas-meters is attended with some danger, owing to the fact that, after a length of time, the glycerine appears to attack the metal working parts of the meter, and give rise to leakage. The quantity of gas consumed last year in Paris amounts to 138,797,811 cubic metres; this figure has to be multiplied by 35·3165 to convert it into English cubic feet.

Les Mondes, August 19, 1869.

This number contains:—

The Electrical Machine of Holtz.—Dr. P. J. Kaiser, the celebrated astronomer and physicist, of Leyden University, and his equally eminent colleague, Professor Ryke, have been not only experimenting with this instrument, but have very much improved its construction, and thereby largely increased its efficacy. We regret that we cannot enter into details on this subject, owing to the fact that, for the proper understanding the woodcut annexed to the original would have to be reproduced.

Theoretical and Practical Studies on the Divers Processes in Use for the Purification (Defecation) of Beet-Root Saccharine Juice by means of Lime and Carbonic Acid.—M. Feltz.—This paper treats, at length, on a subject of considerable importance to the parties more immediately interested, beet-root sugar manufacturers. There is added to it a very precise description of the different methods of estimating the quantity of lime contained in the clarified juice, and, also, divers processes for the quantitative estimation of the organic matters, other than sugar, contained in the said juice. The paper is too long, however, for useful abstraction, and is to be continued in following numbers of this periodical.

We learn from this number that two scientific men of great name in their time have died at an advanced period of life—Prof. Purkinge, of Prague, died on the 24th of July last, aged eighty-two years; Dr. Carus, of Dresden, born in 1789, died also a few weeks ago.

August 26, 1869.

This number contains the following original article:—

Theoretical Chemistry.—M. Maumené.—The author's chief object is to prove that chemists should avail themselves of the author's "Théorie Générale de l'Action Chimique;" and, in order to exhibit it, the author refers to M. Schutzenberger's recent discovery of hydrosulphurous acid. Hydrosulphite of soda, NaO,S_2O_3H, when exposed to heat, after having been carefully dried, yields a little water, sulphur, and sulphurous acid, and leaves a residue consisting of sulphate and sulphuret of sodium. The author of this paper puts the question, Why hydrosulphite of soda should give, under the influence of heat, all the products just enumerated? Why should we not have a more simple action? as, for instance—

$$NaO.S_2O_3H = NaO.SO_3 + HS,$$

or—

$$= NaO.SO_2 + HO + S.$$

Every impartial chemist will at once admit that not one of the hypotheses at present current in the science of chemistry can serve to explain this. My theory exhibits precisely why these more simple actions cannot take place, and why all the bodies observed to be formed by M. Schutzenberger, must of necessity be formed. When a salt is submitted to the action of heat, the acid and base of that salt only constitute, during the action of the heat, a simple mixture acting by equal weight. For one equivalent, E, of one of these two bodies (that is to say, that which has the highest equivalent), the number, n, of the equivalents, E′, of the other body (that the equivalent of which is the lowest) is expressed by the general formula—

$$n = \frac{E}{E'}$$

We have, therefore, in the present instance—

$$n = \frac{57(S_2O_3H)}{31(NaO)} = 1{\cdot}84$$

that is to say, that the equivalent of the acid S_2O_3H, at the moment that the heat becomes strong enough to cause its dissociation from the soda, acts upon 1·84, say, nearly two equivalents of soda. We have, therefore—

$$2NaO + S_2O_3H = NaO.SO_3 + NaS + HO,$$

This first action is followed by a second; one-half of the acid was free; it has, by itself, been exposed to the action of the heat, and gave—

$$S_2O_3H = SO_2 + S + HO.$$

The total result of the decomposition is, therefore, the sum of the equals—

$$2NaO.S_2O_3H = NaO.SO_3 + NaS + SO_2 + S + 2HO.$$

as observed by M. Schutzenberger.

Cosmos, August 21, 1869.

This periodical contains, among other interesting matter:—

Description of the Self-Registering Instruments used at the Kew Meteorological Observatory.—Messrs. R. and J. Beck.—The editor of this paper states that, since these well-known eminent instrument-makers are amongst his subscribers, he has been favoured with the excellent woodcuts and description given by the makers of the instruments.

Discovery of Coal.—On the eastern shores of the Caspian Sea, abundant seams of coal have been found. The steam-ships navigating on that sea have hitherto used wood as fuel, which had to be carried far away from the Ural mountains at great cost. The coal is of very good quality. More than forty years ago, the late A. von Humboldt stated his belief that coal would be found in this region at no great depth under the surface of the ground, since this entire locality abounds in naphtha.

Pharmaceutische Zeitschrift für Russland, May, June, and July, 1869.

These three numbers of this periodical have been published simultaneously, and are, therefore, taken together. The leading article, commenced in the May number, and continued through the two others, is a lengthy monograph on the following subject:—

Best Method of Preparation and Constitution of Hyoscyamine, and the relation this Alkaloid bears to the Quantity of Nitre (Nitrate of Potassa) contained in the Plant wherein the Alkaloid occurs.—M. Thorey.—The author divides this paper into three sections, respectively headed—On the preparation of hyoscyamine; the constitution of that substance; and its relation to the quantity of nitre the plant which yields it contains. The preparation of this alkaloid is described by the author with full details, as given by the very large number of chemists and pharmaceutists who have worked on this subject. Among the various methods of preparation of this alkaloid devised by the author, we notice the following:—50 grms. of *Semina hyoscyami nigri* (common henbane) are ground to powder, exhausted with 150 grms. of alcohol (85 per cent. strength), and the alcoholic tincture concentrated by distillation, one-half of the bulk of the alcohol being distilled off. The residue left in the retort is next mixed with water, filtered, reduced, by evaporation, to about 30 grms., and then again filtered. The filtrate is mixed with a solution of caustic potassa, after having been previously heated to 40°, next treated with chloroform, the chloroformic solution washed with water, until that fluid runs off quite clear, and the solution thus obtained evaporated to dryness, leaving 0·0835 grm. of a yellowish mass smelling like tobacco. This mass is re-dissolved in weak hydrochloric acid, filtered, carefully saturated with caustic potassa, again treated with chloroform, this solution again washed with water, and, at last, left to spontaneous evaporation over sulphuric acid, yields well-crystallized hyoscyamine. The alkaloid thus obtained is a quite pure, colorless substance, of bitter taste, readily soluble in dilute alcohol, in ether and chloroform, in benzine and amylic alcohol, and dilute acids. Among its characteristic chemical reactions, belongs a red amorphous precipitate, with the double iodide of bismuth and potassium; a yellow precipitate, gradually verging on blue, when left standing with phospho-molybdate of soda; a flocculent yellow precipitate with chloride of gold, which, after a time, becomes crystalline; a deep kermes red coloration with aqueous solution of iodine; and an amorphous yellowish gray precipitate with tannic acid. During his researches on this subject, the author has discovered that henbane contains, in addition to hyoscyamine and saltpetre, a peculiar resinous substance, and an acid. The resinous material is remarkable, since it contains nitrogen, its percentical composition being—C, 67·67; H, 8·772; N, 3·508; O, 20·05. As regards the constitution of hyoscyamine, the author says it is, at present, not easily possible to control the statement made by M. Kletzinsky, that this alkaliod should be the nitrile of santonate of ammonia. The question, What relation the hyoscyamine bears to the quantity of saltpetre contained in the plant which yields it? is treated at great length; but it is difficult to give any brief *résumé* of these researches, which are recorded in several tabulated forms full of figures. All parts of the henbane contain a considerable quantity of nitrate of potassa; and it appears that, while that quantity varies at various periods of the growth of the plant, so, also, varies the quantity of hyoscyamine contained in the various parts of the plant. The quantity of hyoscyamine contained in the leaves of the plant dried at 110°, and taken before the blooming period, varies from 0·023 to 0·208 per cent. The seeds contain from 0·048 to 0·160 per cent. of hyoscyamine.

Comparative Study on the Characteristics of the Halogens and their Combinations, and especially, also, on Hyperiodic Acid.—Dr. Ferrein—This monograph contains the history of the halogens (chlorine, bromine, iodine, flourine), treated at length, from the earliest days of Lavoisier and Scheele up to the present time. The essay is too lengthy for any useful abstraction.

PATENTS

Communicated by Mr. Vaughan, F.C.S., Patent Agent, 54, Chancery Lane, W.C.

GRANTS OF PROVISIONAL PROTECTION FOR SIX MONTHS.

1683. H. Holdrege, New York, U.S.A., "Improvements in the process of making gas for illuminating, heating, and other purposes, and in apparatus for the manufacture thereof."—Partly a communication from W. H. Gwynne, New York, and G. W. Harris, Elizabeth, New Jersey, U.S.A.—Petition recorded May 31, 1869.

2039. W. Pidding, Lambeth, Surrey, "Improvements in the mode or modes of obtaining scents, aroma, perfume, or essential oils, from flowers and from all vegetable substances producing the same; also in the machinery or apparatus in connection therewith."—July 6, 1869.

2328. J. T. Way, Kensington, Middlesex, "Improvements in the manufacture of soap, and in cleansing wool and woollen goods."—August 3, 1869.

2345. E. Beanes, Cordwalles, near Maidenhead, Berks, "Improvements in preserving articles of food."—August 5, 1869.

2413. D. Barker, Northfleet, Kent, "Improvements in the manufacture of artificial fuel."—August 12, 1869.

2418. D. A. Gibbs, Milton Street, London, "Improvements in compositions for coating or covering the sides and bottoms of ships and vessels."—August 13, 1869.

2431. W. Matt, Homerton, Middlesex, "An improved compound, or composition, in imitation of marble, veneer, and other substances, to be used in the manufacture of fancy and other articles."—August 14, 1869.

2440. H. Pinkus, Camden Town, Middlesex, "Improvements in furnaces and other heating apparatus, and in the methods of applying and using therewith certain elements of combustion, and in the combinations therewith of the processes, with materials to be used in the manufactures of metals, and other things and uses, and in the mechanical constructions necessary therefor."

2443. J. G. Dale and E. Milner, Warrington, Lancashire, "An improved method of producing white pigments from lead."—August 16, 1869.

2482. F. Braby, Euston Road, Middlesex, "Improvements in the means and apparatus for the manufacture of caustic ammonia and ammoniacal salts."—August 19, 1869.

2490. W. Byrne, Belfast, Ireland, "Improvements in the process of distilling alcoholic liquors, and in apparatus for that purpose."

2493. A. V. Newton, Chancery Lane, "An improvement in the process of manufacturing paint."—A communication from S. R. Bradley, New York, U.S.A.—August 20, 1869

2500. P. A. Blake, Highbury, Middlesex, "A new or improved safety explosive compound or compounds to be used for blasting and other purposes, together with means connected with its use."—August 21, 1869.

2503. T. Gibb and C. Gelstharp, Jarrow-on-Tyne, Durham, "Improvements in the extraction of copper from its ores."—August 23, 1869

NOTICES TO PROCEED.

1224. M. Henry, Fleet Street, London, "An improved mode of obtaining pyrophosphate of lime."—A communication from E. Deligny Boulevard St. Martin, Paris.—Petition recorded April 21, 1869.

1290. S. Oakman, Boston, Suffolk, Mass., U.S.A., "Improvements in the construction of smelting and other furnaces."—April 26, 1869.

1380. W. Mackean, Paisley, N.B., "Improvements in the manufacture of cattle food."—May 5, 1869.

1486. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the treatment of beet-root and other pulps, and in machinery or apparatus employed therein."—A communication from H. Champonnois, Paris.—May 14, 1869.

2364. W. E. Newton, Chancery Lane, "An improved process for purifying or disinfecting alcohol and alcoholic liquors."—A communication from E. J. Maumené, Paris.—August 7, 1869.

2409. J. H. Johnson, Lincoln's Inn Fields, Middlesex, "Improvements in the manufacture of iron and steel."—A communication from J. J. Johnston, Allegheny, Penn., U.S.A.—August 11, 1869.

2501. J. Baur, New York, U.S.A., "Improvements in the manufacture of steel."—August 21, 1869.

NOTES AND QUERIES.

Gas-Works' Residuum.—Can any of your readers give me the name of the most practical work on the conversion of gas-works' residuum.—R. W. Johnson.

Utilisation of Waste Vulcanised Rubber.—Would you kindly answer the following question through your Notes and Queries' column?—In large rubber works, how are the waste cuttings, &c., of vulcanised rubber utilized?—D. J. O.

Terra Alba.—"Selenite" desires some information about the artificial sulphate of lime called, in commerce, terra alba. How is it made? by evaporation of sea-water or brine? Where? Why does its quality vary? At what price is it sold? Its uses? To what extent sold? Is it exported largely? To what countries?

Octylic Alcohol.—Can any of your readers kindly inform me as to the best method of preparing octylic alcohol from saponified castor-oil? I cannot find any means of preventing its frothing over on being heated. I have used an apparatus made of tinned iron for distillation, but find, even though the apparatus is 18 inches high, by 3 inches in diameter, and I only put 3 inches of saponified castor-oil and potash into it, that three-fourths of the matter froths over from the lead-off tube. I can nowhere find any instructions for preventing such an occurrence. I have raised the heat gently, but it makes no difference at all.—G. P. Clarke.

Aniline Colours.—If "Alexis" will have the kindness to state what particular colours he refers to, and the strength in ounces per gallon, I shall be able to furnish him with particulars.—J. W. Slater.

Aniline Colours.—"Alexis" is referred to Reimann's work on aniline colours, edited by the Editor of this journal. The work contains everything which can be desired, and far more fully and completely than any reply we could give in limited space. The work may be inspected at the Library of the Commissioners of Patents; but it should be in the possession of any one who puts queries as "Alexis" does.

Tungstate of Soda.—M. A. Burn is informed that most salts are bad conductors of heat. As to the price of the tungstate of soda, we could not well give any information, since it would greatly depend upon the quantity required; but why will not alum or borax do, or even common salt, provided it be free from deliquescent salts? All these salts are cheaper than the tungstate, and would render paper fire-proof, in the sense of preventing it bursting into flame on being ignited.

Printing Scarlet.—No salts of mercury could be boiled with water in copper, or even iron vessels, without decomposition taking place. If you want to apply the brilliant scarlet colour exhibited by biniodide of mercury, you should apply it by fixing it to the cloth by means of albumen. As far back as the year 1827, it was tried to fix this beautiful pigment by means of mordants, but it did not succeed well. M. Bor, of Amiens, published, in 1842, a method of printing upon cotton a colour resulting from a somewhat complicated process, but, really, the mercury compound you allude to; the printing of this scarlet upon wool and silk does not answer at all. There are various methods of preparing the scarlet biniodide, but for these we must refer you to works on chemistry; however, you could only obtain success by avoiding the use of metallic vessels, and operating in vessels of glass or porcelain. The scarlet of the biniodide of mercury is less beautiful than that of pure vermilion (sulphide of mercury).

Estimation of Phosphates in Manures.—A superphosphate, if properly made, cannot become again insoluble, as long as the superphosphate is acid, which can be readily ascertained by the behaviour of the manure with blue litmus paper, which, when brought into contact with the manure, should turn red; when, however, much iron is contained in a superphosphate (the iron being naturally present in the native phosphate employed in manure making), then it may happen that a basic phosphate of iron is formed by the action of the air—and this may constitute the so-called "reduced" phosphate. No makers of superphosphate will use more sulphuric acid than is precisely required: it would be a loss to them. One equivalent of bone-ash requires two equivalents of sulphuric acid; or, in other words, 155 parts of tribasic phosphate of lime require 98 parts of concentrated sulphuric acid, for being converted into superphosphate of lime. Most, if not all, of the manufacturers of superphosphates are men who conduct their business with conscientious care and upon scientific principles, well knowing beforehand the materials they have to deal with, so as to ensure efficiency of the produce without excess of labour or materials.—Chemicus.

Solid Chloride of Carbon.—Could you kindly inform me of the method for preparing the solid chloride of carbon mentioned in the Chemical News, vol. xx., page 130 (*Am. Repr., Nov.*, '69, *page* 310)? Could it be made from the tetrachloride of carbon?—H. Butt.

Sulphate of Ammonia and Sulphuric Acid.—Can any of your readers inform me of a ready commercial method of determining the percentage of ammonia in sulphate of ammonia, and also tell me the readiest way to find out if pyrites has been used in the preparation of vitriol?—A. Z.

Gas Furnace.—Will any of your readers inform me if it is practicable, by means of an ordinary chimney draft, and gas from the main, to get up a white heat within a cylinder of some 2 ft. diameter and 4 ft. high (the cylinder would be fitted inside with objects for flame to strike against)? if so, I should feel much obliged.—J. C.

Simple Experiment Showing that Air Possesses Weight.—Heat a little water in a flask until the air is purged out, and, while in this state, cork tightly, and set aside to cool. When cool, balance carefully in a good balance, or even ordinary scales; then remove the cork to admit air, and again weigh (including cork): the additional weight of air admitted into the flask will be sufficient to sensibly turn the scale.—W. Nettleton, Huddersfield.

Terra Alba.—In answer to "Terra Alba," this article is not an artificial product, but the finest quality of gypsum stone that can be had, carefully ground to a powder. It is made principally in Derbyshire, and at Leith: it is used for many purposes; it never varies in quality, except according to the quality of the stone it is made from. There is an artificial terra alba sold under the name of pearl hardening, and which is chemically the same, made by precipitation, under the patent of M. Jullien. It contains a larger quantity of water than the natural article. If it is too much dried, it is liable to lose part of its water of crystallisation, and, on addition of water, to set hard like plaster. If your correspondent applies to me, through you, I will give him every information he needs.—Nemo.

Octylic Alcohol.—In reply to your correspondent G. P. Clark, I beg to inform him that the best method of preparing octylic alcohol from castor-oil is the following:—Dissolve one part of caustic potash (or soda, which will do quite as well) in a small quantity of water, add two parts of castor-oil, and heat this mixture in a large iron pot until all frothing ceases, and a smell of mushrooms is given off. Introduce the solid mass thus obtained into the still, and conduct the distillation as quickly as possible. To purify the crude alcohol, it has to be rectified several times over fused caustic potash, the portion boiling below 200° C. only being collected. Besides higher boiling products, hydrocarbons having a lower boiling point are also present, and are easily removed by fractional distillation. Instead of using castor-oil, castor-oil soap may be used, which has first to be heated with caustic alkali, in an open vessel, as described above.—C. Schorlemmer, Owen's College, Manchester, September 11th, 1869.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

*** It is our pleasing duty to accord our best thanks to those gentlemen who have so kindly acceded to our request in sending us the necessary information respecting the Chemical and Medical Schools for our Students' Number.

Bichrome.—Your letter involves a legal question; we would rather not offer any advice on the subject.

Walter Weldon.—In reporting a paper by this correspondent in our last issue he was styled "F.C.S." He has written to ask us to correct this error, as he is not yet a Fellow of the Chemical Society.

E. B.—("Explosion Caused by Ammonia Gas.") In the original paper it reads exactly as printed in our issue of the 3rd inst.: we believe, however, it is a typographical error in the German paper, and we intended to have made a remark to this effect in our abstract, as we are well aware that no iron vessel of the dimensions specified would stand such an enormous pressure; we venture the explanation that the total force exerted at the time of the explosion was 20,000 pounds, not on the square inch, but over the entire surface of the vessel. On inspection of other German periodicals we find that they also have reproduced this error. The vessel was made of wrought-iron.

J. Cubitt.—You will find full particulars on the subject you name in Watts's "Dictionary of Chemistry," vol. v., p. 276.

L. W. Longstaff.—Dr. Roscoe's new work on spectrum analysis, published by Macmillan, is the most complete work on the subject.

W. Carston.—Consult "Annaire Almanach de Commerce, de l'Industrie, de la Magistrature, et de l'Administration, ou Almanach des 500,000 adresses (Didot-Bottin), 72e année, 1869." You can see this work at the library of the Patent Office, and possibly at one of the libraries, or the French Consulate Office in Edinburgh.

W. Seddon.—(1) A number of works on this subject have been published; amongst them we may name "A Treatise on Coal and Coal Mining," by W. W. Smyth, M.A., F.R.S., &c. (Virtue); "Coal and Coal Oil" by Eli Bowen, Philadelphia, U.S. (Burat La Houille, Paris): several editions of this work have appeared. (2) Galvanic batteries are made so cheaply by philosophical instrument makers that it is scarcely worth while to make them; but any work on natural philosophy will give you sufficient information about their construction.

Books Received.—"Transactions of the Epidemiological Society of London," vol. III., part I. London: Hardwicke. "Canterbury Water Supply;" Chemical Report, by Dugald Campbell, Esq., F.C.S., 1869. "American Reprint of the Chemical News" for September, 1869. "Treatment of Human Excreta," by J. C. Lee. Manchester: J. Heywood.

AMERICAN SUPPLEMENT.

New York, November, 1869.

The Occurrence of Laurite and Diamonds in the Native Platinum of Oregon.

A communication from Prof. F. Wöhler to the Editor, dated Göttingen, July 22d.

In the native Platinum from Oregon I have found the new mineral composed of sulphide of ruthenium and sulphide of osmium, discovered by me in the Borneo platinum, and to which I gave the name Laurite.

The crystalline grains are very small, but by magnifying them fifty diameters it was possible to distinguish them by their peculiar lustre from the dull grains of chromic iron. As it was impossible to separate the grains of Laurite from the other minerals present, a quantity of the entire mineral was subjected to chemical examination.

The platinum and gold were withdrawn by aqua regia.

The chromic iron was separated as much as possible by fusion with bisulphate of potassa, and subsequent treatment with dilute hydrochloric acid.

The silica was expelled by treatment with hydrofluoric and sulphuric acids.

The residue was then thoroughly washed.

On examining the material thus purified under the microscope, it was seen to contain numerous grains of undecomposed chromic iron, beside iridosmine, and different transparent minerals, some colored, some colorless, specially minute crystals of hyacinth, which had hardly been attacked by the hydrofluoric acid.

The mixture was placed in a glass bulb tube, and ignited in a current of hydrogen entirely free from sulphuretted hydrogen. The formation of sulphuretted hydrogen began as soon as the bulb was raised to a red heat, and continued for some time. I have elsewhere shown that it is a peculiar property of this otherwise difficultly decomposable mineral, to give up all its sulphur on ignition in hydrogen.

The residue was then treated with hydrochloric acid to remove iron. But although hydrogen was evolved on the application of the acid, the solution contained merely a trace of iron. On adding ammonia to it, a white precipitate was obtained, which by ignition in hydrogen yielded globules of tin.

The ore, thus freed from the iron and tin, was then treated with aqua regia, when it yielded a brown solution, in which chloride of ammonium precipitated a small quantity of black double chloride of iridium and ammonium. The entire solution was then evaporated to dryness with an excess of chloride of ammonium, and ignited in a porcelain crucible. There remained a grayish black metallic powder, which was fused in a silver crucible with hydrate of potassa and a little nitre. The fused mass dissolved in water, yielding the characteristic orange-colored solution of rutheniate of potassa, and leaving a very small quantity of oxide of iridium undissolved. On adding nitric acid to the solution, a black precipitate of oxide of ruthenium was produced, and at the same time was perceived the ozone-like odor of ruthenic acid, and later, the characteristic odor of osmic acid.

In a subsequent communication, dated Göttingen, Aug. 8, Prof. Wöhler continues: On examining under the microscope the mineral powder, which had been freed from platinum, gold, chromic iron (in part), silica, iron, and tin, and from which the ruthenium, &c., had been removed by aqua regia; besides many grains of chromic iron and beautiful hyacinth crystals, colorless and transparent grains resembling quartz were noticed, and also grains resembling rounded diamond crystals. To ascertain whether these crystals were really diamonds, a gramme of the powder was ignited in a stream of pure oxygen gas to convert the carbon into carbonic acid. The powder was placed in a freshly ignited platinum boat, in a new porcelain tube, which had previously been ignited while oxygen was passed through it to destroy any dust that it might contain. On igniting the powder and conducting the stream of gas through baryta water, a heavy cloudiness was at once produced, but the precipitate soon began to assume a brown color, and a black deposit, probably of oxide of ruthenium, was deposited in the tube. On pouring hydrochloric acid into the tube, the precipitate was dissolved, with a visible evolution of gas, which, conducted into baryta water, produced a cloudiness.

I am satisfied, therefore, that besides the laurite, iridosmine, chromic iron, hyacinth, etc., the Oregon platinum contains microscopic crystals of diamond.

On the Quantitative Separation and Determination of Iodine, Bromine, and Chlorine.

The determination of iodides and bromides in the presence of large quantities of chlorides, is a very important problem in analytical chemistry. I have had occasion lately to examine sponges and several mineral waters for iodine and bromine, and as these elements are among the principal constituents that give value to waters and to the ashes of sea-weeds and sponges, it was a matter of great importance to determine them with accuracy. The plan for analyzing waters now generally employed, is to treat the alkaline salts, that have been freed from the other constituents, several times with alcohol, in order to separate iodides and bromides from the large excess of chlorides, that are usually contained in mineral waters. This treatment with alcohol has to be repeated the more frequently, the less potassa salts a water contains, for the respective salts of potassa are more readily soluble in alcohol than those of soda.

This having been done, the iodine is precipitated with chloride of palladium (not with the nitrate, as this will precipitate also bromine), and in the filtrate from the iodide of palladium, chlorine and bromine are precipitated with nitrate of silver, after removing the excess of palladium.

The palladium is best removed by hydro-sulphuric acid, and the excess of this destroyed by sulphate of the sesquioxide of iron, or by evaporating to dryness with carbonate of soda and igniting the residue.

The precipitate of chloride and bromide of silver is washed, dried, and weighed, and a weighed portion of it converted into chloride of silver, by passing over it a current of dry chlorine gas in the usual way. The difference in these weights gives the data for the calculation of the chlorine and bromine.

The chlorine is better determined in a fresh portion by precipitating all the haloids with nitrate of silver, and subtracting iodide and bromide of silver, leaving the weight of the chloride.

The same method may be followed in the analysis of ashes. In order to determine iodine and bromine in sponges, they may be incinerated after the addition of a solution of carbonate of soda, or dissolved in water

under pressure (a pressure equivalent to 230° C. being required), the solution evaporated with carbonate of soda and ignited; or the iodides and bromides separated by dialysis from the organic matter, and proceeded with in the same manner as described for waters.

The separation of the large excess of the chlorides from the iodides can also be effected by nitrate of silver; for in precipitating a solution of 100 gr. of chloride of sodium, to which were added 0·2989 gr. of iodide of potassium, with nitrate of silver, until the precipitate came down white, and digesting it for some time with the fluid, it could be filtered off without the filtrate containing any iodine, by which it seems as though the iodide of silver, which otherwise would be dissolved in an excess of chloride of sodium, is replaced by chloride of silver.

This precipitate was then decomposed by Hydro-sulphuric acid, the excess of this acid destroyed by sesquisulphate of iron, and the iodine precipitated with chloride of palladium.

It gave 0·0942 gr. metallic palladium, equivalent to 0·2950 gr. or 98·71 per cent. of the iodide of potassium taken. This method does not, however, offer any peculiar advantages over the old one.

I give below a number of figures which may perhaps be useful with regard to the treatment of precipitates obtained in analyzing substances containing iodine and bromine, and which may, perhaps, suggest some new ideas.

(1.) 0·6061 gr. K I were dissolved in water acidulated with nitric acid, and precipitated with an excess of nitrate of silver.

The precipitate was, after drying and igniting, heated to fusion with the usual precautions; it yielded 0·8570 gr. Ag I=0·6058 gr. K I=99·95 p. c. of the quantity taken.

(2.) 0·5180 gr. K I were treated in the same way, the precipitate filtered on a weighed filter; it yielded by drying it:

For 60 hours over HO,SO_3=1·1149 gr. Ag I=0·5222 gr. K I=100·81 p. c.
For 84 hours over HO,SO_3=1·1092 gr. Ag I=0·5182 gr. K I=100.01 p. c.
For 5 hours at 170° F.=1·1057 gr. Ag I=0·5156 gr. K I=99·53 p. c.
(Weight of filter=0·3761 gr.)
After igniting and fusing=0·7324 gr. Ag I=0·5177 gr. K I=99 94 p. c.

By long-continued drying the filter will have a reducing action on the iodide.

(3.) 0·5929 gr. K I were mixed with 1 gr. Na Cl and precipitated with a solution of Ag Cl in NH_4O; after standing for twenty hours the precipitate was filtered out, washed, and dried:

For 60 hours over HO,SO_3=0·8429 gr. Ag I=0·5961 gr. K I=100·54 p. c.
For 84 hours over HO,SO_3=0·8359 gr. Ag I=0·5911 gr. K I=99·69 p. c.
For 5 hours at 170° F.=0·8304 gr. Ag I=0·5869 gr. K I=98·99 p. c.
After igniting &c.=0·8342 gr. Ag I=0·5896 gr. K I =99·45 p. c.

The precipitate, if dried, must therefore only be dried over HO,SO_3.

(4.) 0·7240 gr. K Br, treated as under No. 1, gave, after ignition:

1·1337 gr. Ag Br=0·7177 K Br=99·13 p. c.

The bromide of potassium was not tested as to its purity.

(5.) 0·1803 gr. K I were dissolved in water slightly acidulated with nitric acid, PdO,NO_5 added, warmed, and, after 24 hours' standing, filtered on a weighed filter, it gave:

After 3 hours' drying at 180° F.=0·2071 gr. Pd I
" 4 " " " " =0·1964 gr. "
" 5 " " " " =0·1964 gr. "
=0·1809 gr. K I=100·33 p. c.
After ignition in air=0·0589 gr. Pd=0·1836 gr. K I =101.83 p. c.

(6.) 0·3250 gr. K I treated in the same way gave:

After 60 hours' drying over HO,SO_3=0·3539 gr. Pd I =0·3266 K I=100·33 p. c.
After 84 hours' drying over HO,SO_3=0·3522 gr. Pd I =0·3245 K I=99·84 p. c.
After 5 hours' drying at 180° F.=99.07 p. c.
After ignition in air=101·79 p. c.
" " under hydrogen=100·02 p. c.

(7.) 0·2072 K Br, treated in the same way, gave,

After drying at 170° F. for 4¼ hours:
=0·1954 gr. Pd Br=0·1746 K Br=84·21 p. c.
After igniting in air
=0·0827 gr. Pd=0·1849 K Br=89·23 p. c.

It is therefore necessary to precipitate iodine, from solutions containing bromine, with chloride of palladium, and either to dry or ignite the residue under hydrogen.

I give here also the determination of potassa in iodide of potassium, according to the method described in H. Rose's Lehrbuch:

60 hours' drying over HO,SO_3=0·6699 gr. $PtCl_2$, K Cl =0·4546 K I=99·82 p. c.
84 hours' drying over HO,SO_3=0·6623 gr. $PtCl_2$, K Cl =0·4491 K I=98·62 p. c.
5 hours' drying at 170° F.=0·6556 gr. $PtCl_2$, K Cl= 0·4446 K I=97·93 p. c.
after igniting=99·88 p. c.

Paul Schweitzer, Ph.D.
School of Mines, Columbia College.

Colors from Petroleum Residues—a Swindle.

We were lately requested to give an opinion with regard to some samples of colors which a chemist (?) pretends to have made from petroleum residues, and in which he is seeking to interest capitalists. The specimens were very beautiful, but they resembled very closely the bronze powders which are extensively imported from Germany. We at once tested them for metals, and found that the brilliant red consisted of finely divided copper, the golden specimens of brass, and the silver white specimen chiefly of tin. The colors are simply metallic powders, and cannot, of course, have been extracted from petroleum residues. This is a gross imposition, which any chemist would at once detect.

Dangerous Kerosene.

The Board of Health continues to publish the addresses of dealers who sell dangerous kerosene, and suits were long ago commenced against a large number of them. But, thanks to the very tardy administration of justice in this city, the cases have dragged along for several months without coming to a trial. There is, however, a prospect that something will be done, and, as we go to press, we learn that the trial will certainly come off on Tuesday, October 18, *unless it is postponed.*

In the meantime, while some one is neglecting his duty, the kerosene murders continue. The newspapers

have recorded a considerable number of serious accidents since our last issue, some resulting in loss of property, others in the death—in some cases slow and protracted—of the unfortunate victims. "Liquid safety gas" and adulterated kerosene are still freely sold, with no fear of punishment; but let those death-dealing tradesmen consider that though they may escape immediate punishment for their cruel disregard of human life, the few cents per gallon, which they now make, is a very poor inducement for the crime against humanity, which they are daily committing.

Recent Chemical Patents.

Issued September 21, 1869,

94,942.—Apparatus for Evaporating Cane-Juice. M. S. Bringier, Ascension Parish, La.

94,959.—Apparatus for Evaporating Cane-Juice. L. S. Hereford, West Baton Rouge Parish, La.

94,969.—Method of Purifying Nitric Acid. G. M. Mowbray, Titusville, Pa.

94,994.—Manufacture of Iron and Steel. H. Bessemer, London, England.

94,995.—Manufacture of Iron and Steel. H. Bessemer, London, England.

94,996.—Manufacture of Iron and Steel. H. Bessemer, London, England.

94,997.—Manufacture of Iron and Steel. H. Bessemer, London, England.

95,017.—Manufacture of Galvanized Iron. J. D. Grey, Pittsburg, Pa.

95,036.—Composition for Use in Fire Extinguishers. J. M. Muterse and H. G. De Valory, Guérande, France.

95,039.—Extract of Madder for Dyeing and Printing. A. Paraf, New York.

95,040.—Process for Printing Colors on Textile Fabrics. A. Paraf, New York,

95,053.—Nickel-Faced Type. L. L. Smith, Brooklyn, N. Y.

95,075.—Manufacture of White Lead. S. R. Bradley, New York.

95,097.—Manufacture of White Lead. C. W. Dwelle, St. Louis, Mo.

Issued September 28, 1869.

95,201—Manufacture of White Lead. James Cuddy, Pittsburg, Pa.

95,295.—Process of obtaining Wrought Iron directly from the Ore. J. D. Whelpley and J. J. Storer, Boston, Mass.

95,307.—Process for Utilizing the Sulphur Fumes from Copper Ore. A. Bigelow, Newark, N. J.

95,342.—Soap or Detergent Compound. E. R. Breed, Farmington, Ill.

95,317.—Extract of Hops. H. Burgess, Royers Ford, Pa.

95,358.—Manufacture of Cast-Steel. L. La Breche-Viger, Montreal, Canada.

95,365.—Bleaching Paper-Stock. G. E. Marshall, Laurel, Ind.

95,377.—Medicated Soap. W. P. Pugh, High Point, N. C.

95,403.—Paint-Compound. J. Gould, Lexington, Mass.

Issued October 5, 1869.

95,405.—Composition for Making Types for Printing Wall-Paper, Oil-Cloth, and other Fabrics. R. A. Adams, New York.

95,412.—Apparatus for Carburetting Air and Gas. A. Barbarin, New Orleans, La.

95,419.—Purifying Iron and Steel, or other Metal. E. Brady, Philadelphia, Pa.

95,445.—Apparatus for Evaporating and Decomposing Liquids. A. Eckstein, Vienna, Austria.

95,459.—Manufacture of Coal-Gas. W. Gibson, Cambridge, Mass.

95,465.—Process of Preparing Alizarine. C. Graeb, Frankfort-on-the-Main, and C. Liebermann, Berlin, Prussia.

95,473.—Process of Seasoning Wood. T. W. Heinemann, New York.

95,474.—Process and Apparatus for Preserving Wood. T. W. Heinemann, New York.

95,484.—Manufacture of White Oxide of Zinc. R. Jones, Mount Holly, N. J.

95,494.—Marine Paint. W. H. Lewis, Boston, Mass.

95,496.—Manufacture and Refining of Sugar. L. J. F. Margueritte, Paris, France.

95,534.—Manufacture of Pigments for Paints. R. S. Stenton, New York.

95,568.—Manufacture of Iron and Steel. N. Cutter, Cincinnati, Ohio, and E. Savage, West Meriden, Conn.

95,574.—Process of Distilling Spirits. J. Ellingwood, Owensborough, Ky.

95,583.—Process of Treating Wood, to Preserve, Season, and give it a better Surface. J. Hayford and J. F. Paul, Boston, Mass.

95,624.—Mode of Applying Inks of Different Characters, so as to Print Safely, Revenue, and other Stamps. W. Thorpe, St. Louis, Mo.

95,626.—Ink for Printing Revenue, Postage, and other Stamps, so as to secure greater safety and prevent frauds. T. Antisell, Washington, D. C.

Issued October 12, 1869.

95,665.—Manufacture and Application of Gas from Petroleum, &c. T. H. Dickerson, Chicago, Ill.

95,668.—Evaporating Salt Water, &c. W. J. Dodge, Syracuse, N. Y.

95,679.—Soap. H. L. Guldin, Robeson Township, Pa.

95,686.—Apparatus for Heating Puddling Furnaces. S. A. Hill and C. F. Thumm, Oil City, Pa.

95,687.—Device for Generating Steam in Steam-Generators. S. A. Hill and C. F. Thumm, Oil City, Pa.

95,688.—Apparatus for Generating Steam in Boilers. S. A. Hill and C. F. Thumm, Oil City, Pa.

95,696.—Fire-Proof Paint. E. Kunzendorf, New York.

95,740.—Distilling Apparatus for Spirits. F. Sonier, Springfield, Ill.

95,752.—Manufacture of Crystal Glass. Otto Wuth, Pittsburg, Pa.

95,798.—Apparatus for Drying Sugar. A. Herbst, Moscow, Russia.

95,843.—Manufacture of Iron and Steel. C. W. Siemens, Westminster, England.

Reissues.

83,182, reissue 3,647.—Printing Certain Textile Fabrics and Yarns. American Print Works, Fall River, Mass.

92,934, reissue 3,667.—Method of Preserving the Aromatic Principle of Hops. E. D. Brainard, Albany, N. Y.

94,073, reissue 3,668.—Manufacture of Soap. W. T. Bush, Union City, Tenn.

NEW PUBLICATIONS.

Cyclopædic Science Simplified. By J. H. Pepper. London: Frederick Warne & Co. New York: Scribner, Welford & Co.

Probably no man in England has accomplished so much in the way of popularizing science as Mr. Pepper, Professor of Chemistry and Honorary Director of the Royal Polytechnic Institution of London. With a sound education, good natural ability, and a liberal supply of money, combined with that tact in presenting his subject to his audience, so necessary for success in this field of education, Prof. Pepper has established a wide popularity as a scientific lecturer.

In presenting the truths of science to a general audience, good judgment is necessary to present the salient points of the subject with striking illustrations, which will impress the facts permanently upon the minds of the hearer, abstaining from any lengthy discussion of abstruse and, save to the scholar, uninteresting phenomena and their causes; avoiding both the Scylla and Charybdis of many lecturers, the superficiality of that numerous class of charlatans who style themselves popular lecturers, on the one hand, and the tedious prolixity and particularity of many of the learned scientists, on the other hand.

This middle course Prof. Pepper has closely pursued, and thus deservedly ranks foremost among popular educators.

In the work now published he has adopted the same course as in his lectures, and has placed before the public a treatise of great value. The major part of the book is devoted to physics, the principles and theories of which are clearly and concisely stated, with full experimental illustrations. The latter portion of the book is devoted to chemistry, the properties and chemical reactions of the elements being briefly, but clearly, described. The more recent chemical and physical discoveries and applications are fully explained.

As a compilation of scientific information for popular reference, we do not think the work is excelled.

The book is handsomely printed upon tinted paper, and fully illustrated by several hundred woodcuts, the execution of which reflects great credit upon the publishers.

The Polytechnic. A semi-monthly paper devoted to the interests of polytechnic and scientific schools. Troy, N. Y.

We have received the first number of this journal, a handsomely printed quarto of twelve pages, edited by Mr. Montague L. Marks.

The subject matter of this first number is excellent, and we are happy to chronicle its establishment as the mouthpiece of the Rensselaer Polytechnic Institute, by far the leading school of civil-engineering in this country.

Paris Universal Exposition, 1867. Reports of the United States Commissioners.

The Progress and Condition of Several Departments of Industrial Chemistry. By J. Lawrence Smith, United States Commissioner.

In a pamphlet of 146 pages, Prof. Smith reports the progress of several branches of industrial chemistry, including the manufacture of sulphuric acid, soda and salts of soda, potash and its compounds, ammonia, baryta, magnesia and alumina, chlorine, fluorine, manganese, and carbonic acid; the industrial productions of oxygen, hydrogen, and other elements; the manufacture of illuminating gas from coal, and the utilization of the waste products, and the stearic acid industry. In a future number, a detailed review of this important contribution to the history of technical chemistry will be presented.

The American Journal of Science and Arts for September contains the following articles specially interesting to chemists: 1. On Durangite, a fluoarsenate from Durango in Mexico. By G. J. Brush. 2. Remarks on the Galvanic Battery. By G. W. Hough. 3. On Nitric Acid and Chlorate of Potassium as an Oxydizing Mixture Applicable to Sulphur, Sulphids, Chromium, Arsenic, Organic Matters, etc. By F. H. Storer. 4. On the Action of Light on Uranium. By H. C. Bolton. 5. On the Action of the Alkaline Nitrites upon Uric Acid and its Derivatives. By Wolcott Gibbs. 6. On the Meteoric Stone which fell Dec. 5th, 1868, in Franklin Co., Alabama. By G. J. Brush. 7. On the Lesleyite of Chester Co., Penn., and its Relations to the Ephesite of the Emery Formation near Ephesus, Asia Minor. By J. Lawrence Smith.

BREVITIES.

Lyceum of Natural History.—At the meeting of the chemical section of this society, October 11th, President Newberry in the chair, the following papers were presented and read: "A Memoir of the late Prof. Graham," by Prof. Joy, which was, however, owing to the absence of published material, not so much a memoir of the life of this savant, as an account of his works. Prof. Joy enumerated the titles of the principal papers of Graham, amounting to thirty, and mentioned his four important discoveries. Dr. Paul Schweitzer read a paper "On the Quantitative Separation and Determination of Iodine, Bromine, and Chlorine," which is printed in full in another portion of this journal. Prof. Charles A. Scely then spoke "On Dissociation," calling the attention of the Society to the want of literature on the subject, and giving his explanation of the phenomena of dissociation. Prof. Joy and Mr. Walz joined in the discussion. Mr. O. Loew, after reading a paper "On the Action of Sunlight on Iodide of Potassium," exhibited some closed glass tubes, containing a solution of this salt, which had assumed a yellow color, owing to the oxygen contained in the tubes. He also exhibited a tube filled with bisulphide of carbon, which by the action of sunlight had been converted into a black solid mass of sesquisulphide of carbon.

The American Institute Fair.—The Thirty-eighth Exhibition of the American Institute was opened September 5th, the opening address being delivered by Mr. Horace Greeley. The exhibition of American woollen manufactures is especially fine, the array of carpets of all grades, bunting, cloths, and dress goods being very extensive and brilliant. This is the most conspicuous portion of the exhibition, and specially gratifying to our national pride. It was hoped that all the accessory branches of industry would be well represented; but this hope has not been realized: the exhibition of woollen machinery is not as good as it should be, and raw materials, as well as printers' and dyers' chemicals and dyestuffs, are almost wholly unrepresented. This is greatly to be regretted, and not at all to the credit of the enterprise of the manufacturing chemists of this country. The department of chemistry and mineralogy is very insignificant. Messrs. Feuchtwanger exhibit specimens of the soluble alkaline silicates, and a few minerals. Messrs. F. W. Devoe's collection of colors and oils is very fine, and the best effort in the department. The exhibition of oils, etc., by Charles Pratt, is excellent, the specimens being numerous and handsome. Patterson & Brazeau exhibit artificial mineral waters, as well as the dry salts for making Kissengen, Vichy, and Congress waters. These salts will prove desirable for transportation to distant markets. Enoch Morgan's Sons have a good collection of soaps, and a fine crystallization of sal-soda; and Colgate & Co., and B. T. Babbitt, add to this portion of this department. A number of handsome specimens of graphite from Joseph Dixon & Co., some fine specimens of steel from the New York Steel Works, soluble Prussian blues, "Dry Extract of Annatto," "The Texan Liebig's Extract of Meat," "The Phœnix Disinfectant," an assortment of whiskies, rectified by distillation in vacuo, and Horsford's and Lauer's phosphoric acid bread powders, complete the catalogue of this department.

In other departments are many articles of interest to chemists. Among these we notice Gardner's method of lighting gas by the ignition of a platinum wire placed over the burner; Captain Kennedy's electric clock, curious, though it cannot be accurate for astronomical work, under all electric conditions of the atmosphere; a case of nickel-plated goods, not as handsome as silver, but less easily tarnished; a good collection of thermometers, hydrometers, and hygrometers from the leading manufacturers of New York; and a fine display of photographs, etc., from the best establishments. Altogether, the exhibition is exceedingly interesting, but not as complete, in many departments, as we supposed it would be.

Prof. Silliman has been appointed State Chemist of Connecticut by Governor Jewell.

Prof. A. K. Eaton will occupy the chair of Chemistry in the Eclectic Medical College of the City of New York.

Samuel Jones, A.M., has been elected Professor of Natural Philosophy and Chemistry in Washington and Jefferson College, Washington, Penn.

Prof. Henry Morton, of Philadelphia, the editor of the Journal of the Franklin Institute, has been elected Professor of Mechanics in the University of Pennsylvania.

Mr. George Peabody has made a further donation of $400,000 to the Peabody Institute of Baltimore.

Professors Lyman and Newton, of Yale College, have returned from Europe, with important additions to the collections of physical and mechanical apparatus.

In the University of South Carolina, Dr. A. G. Mackey has been elected Professor of Natural and Mechanical Philosophy, Dr. Joseph Jones Professor of Chemistry, and Mr. T. E. Hart Professor of Mathematics, to supply the vacancies occasioned by the resignations of Professors John Le Conte, Joseph Leconte, and E. P. Alexander.

The Project of a Grand International Exhibition, in Washington, in 1871, is being discussed. At a recent trade-congress in the West, the same subject was proposed, and the claims of the Mississippi Valley urged for the location of the fair in one of its cities.

The Estimated Income of the Smithsonian Institution, for 1869, is $53,100, an excess of $8,567 over the estimated expenditures.

The Estimated Expenses of the British Museum for 1869–70 are estimated at 113,203*l.*, which is 13,823*l.* more than the expenditures of last year.

The Thayer School of Civil Engineering, connected with Dartmouth College, has a total endowment of $60,000.

The Halsted Observatory, of Princeton, is nearly completed. The telescope, which is being constructed by Abram Clark & Sons, of Cambridgeport, Mass., will have an object-glass 25 inches in diameter, and a focal length of 30 feet. The total cost of the observatory will be not far from $200,000, which is being defrayed by Gen. Halsted, of Newark, N. J.

AMERICAN DRUGGISTS' PRICE-CURRENT—NEW YORK.—JOBBERS' PRICES.

DRUGS AND CHEMICALS.

Aceton	per oz		to		35
Acid, Acetic, No. 8	per lb		to		22
sp. gr. 1,047 U.S.P.	per lb		to		25
Chemically Pure	per lb		to		55
Glacial	per lb		to	1	60
Benzoic, German	per oz		to		30
Boracic, pure	per lb		to		85
Citric	per lb		to	1	00
Fluoric, 1 lb bottles	per lb		to	2	30
Formic	per lb		to	3	00
Gallic	per lb		to	2	75
Hydrophosphorous	per lb		to	4	25
Lactic	per lb		to	4	25
Muriatic, 18 degrees	per lb		to		5
chemical pure	per lb		to		35
Nitric, 38 degrees	per lb		to		15
chemical pure	per lb		to		38
Oxalic, patent	per lb		to		33
Phosphoric, glacial	per lb		to	3	00
Prussic	per oz	8	to		9
Sulphuric	per lb	4	to		5
chemical pure	per lb		to		48
Valerian	per oz		to	1	40
Tartaric, powdered	per lb		to		78
Aconite Leaves	per lb		to		28
Aconitia	per dr		to	5	00
Agaric Alba	per lb		to		80
Alcohol, 95 per ct	per gal		to	2	60
Aloes, Cape, powdered	per lb		to		34
Socotrine, powdered	per lb		to	1	00
Alum, Roman	per lb		to		11
lump	per lb		to		4½
Ambergris, gray	per oz		to	14	00
Ammonia Carbonate, bulk	per lb		to		24
in jars	per lb		to		25
Muriate	per lb		to		18
Ammonia Aqua, 20 degrees	per lb		to		12
26 degrees	per lb		to		22
Hypophosphite	per lb		to	4	00
Oxalate	per lb		to	2	00
Phosphate	per lb		to	2	00
Sulphate	per lb		to		10
Ammonium Valerian. Crystals	per oz		to	1	10
Ammonium Bromide	per lb		to	2	25
Hydrosulphuret	per lb		to		75
Iodide	per lb		to	8	50
Amygdalin	per oz		to	3	75
Antimony and Potass	per lb		to	1	10
Butter	per lb		to		28
Arnica Leaves	per lb		to		20
Arrow Root, Bermuda	per lb		to		45
St. Vincent	per lb		to		18
Arsenic, white powdered	per lb	8	to		10
red pulv	per lb		to		30
red, lump	per lb		to		20
Arsenic Solution, Fowler's	per lb		to		15
Iodide	per oz		to		90
Sol., Donovan's	per lb		to		28
Asbestos	per lb		to		15
Asparagin	per oz		to		
Atropia	per dr		to	3	00
Sulphate	per dr		to	3	00
Valerian	per dr		to	4	50
Balsam Fir	per gal		to	3	50
Copaiva	per lb		to		95
Peruvian	per lb		to	6	50
Tolu, true	per lb		to	1	30
Barbadoes Tar	per lb		to		12½
Bark, Elm	per lb		to		18
Bark, Calisaya, quill	per lb		to	1	65
Red, quill	per lb		to	1	85
Pitayo	per lb		to		80
Cascarilla	per lb		to		22
Mezereon	per lb		to		28
Sassafras	per lb		to		10
Baryta Muriate	per lb		to		30
Nitrate	per lb		to		40
Bay Rum	per gal		to	3	00
Bebeerin, pure	per oz		to	5	50
Sulphate	per oz		to	3	50
Belladonna Leaves	per lb		to		25
Bicarbonate Soda	per lb		to		6½
Bichromate Potash	per lb		to		28
Bismuth Metallic	per lb		to	8	00
and Ammonia Citrate soluble	per oz		to		90
and Ammonia Citrate Solution	per lb		to		95
Oxychloride	per lb		to	7	00
Subcarbon	per lb		to	8	00
Sub-Nitrate	per lb		to	7	00
Tannate	per oz		to	1	30
Valerianate	per oz		to	2	35
Black Drops	per lb		to	5	00
Blue Mass	per lb		to		56
Bole, Armenia true	per lb		to		10
Borax, refined	per lb		to		40
Brimstone, roll	per lb		to		5
Bromine	per lb		to	2	50
Brucia	per oz		to	3	75
Buchu Leaves, long	per lb		to		60
short	per lb		to		38
Burgundy Pitch, true	per lb		to		14
Cadmium, Bromide	per oz		to		40
Iodide	per oz		to		55
Metallic	per lb		to	4	40
Sulphate	per oz		to		35
Caffeine	per oz		to	8	50
Calcium Chloride	per lb		to		90
Iodide	per oz		to		50
Calisaya Bark, Milhau's Original Elixir of	per doz		to	11	00
" " "	per gross		to	120	00
Calisaya Bark, Milhau's Chalybeate Elix. of	per doz		to	11	00
" " "	per gross		to	120	00
Calomel, Hydrosub	per lb		to	1	00
Camphor, Refined	per lb		to		85
Cannella Alba	per lb		to		25
Cantharides, powdered	per lb		to	2	20
Carbolic Acid crystals	per oz		to		15
" " solution	per lb	60	to		85
" " " common	per lb		to		35
Carbon Bi-Sulphuret	per lb		to		42
Cascarilla Bark	per lb		to		20
Cassia Buds	per lb		to	1	15
Castor Oil	per gal		to	2	50
Caustic Soda	per lb		to		9
Centaury Minor	per lb		to		30
Cerium, Oxalate	per oz		to	1	05
Nitrate	per oz		to	1	60
Chalk, Precip., English	per lb		to		28
Cherry Laurel Water	per lb		to		58
Chlorate Potass, English	per lb		to		48
Chloride Lime	per lb		to		8
Chloroform	per lb		to	1	35
Cinnamon, Ceylon, true	per lb		to	1	70
Citrine Ointment	per lb		to		58
Civet	per oz		to	5	50
Cobalt	per lb		to		26
Cocculus Indicus	per lb		to		38
Cocoa Butter	per lb		to	1	00
Codeine	per dr		to	2	50
Cod Liver Oil	per gal		to	2	10
Cod Liver Oil, (" Shore Oil ")	per gal		to	2	00
Cod Liver Oil, J. C. Baker & Co.'s	per doz		to	2	00
" " "	per gross		to	90	00
" " " .5 gross,	per gr		to	87	00
Cod Liver Oil, Hazard & Caswell's	per doz		to	7	50
" " "	per gr		to	90	00
Cod Liver Oil, Milhau's Golden	per doz		to	7	00
" Milhau's Etherized	per gross		to	78	00
Cod Liver Oil, Milhau's, with the Hypophosphite of Lime	per doz / per gross		to	7 / 84	50 / 00
Collodion	per lb		to	1	60
Cantharidal	per doz		to	4	50
Colocynth, powdered	per lb		to		75
Confectio Rosæ	per lb		to		45
Sennæ	per lb		to		45
Conium Leaves	per lb		to		25
Coniin	per oz		to	7	50
Copper Ammoniated	per lb		to	1	20
Black Oxide	per lb		to	2	20
Carbonate	per lb		to	2	20
Sulphate, pure	per lb		to		38
Copperas	per lb		to		4
Corrosive Sublimate	per lb		to		90
Cream Tartar, powdered, pure	per lb		to		47½
Cubebs	per lb		to		32
Cubebin	per dr		to		25
Cuttlefish Bone	per lb		to		28
Digitalis Herb	per lb		to		18
Digitaline	per dr		to	3	65
Dover's Powder	per lb		to	2	87½
Dragon's Blood, mass	per lb		to	1	00
reeds	per lb		to	1	10
Dulcamara Stems	per lb		to		18
Emetine	per oz		to	3	65
Emery Corn	per lb		to		10
Flour	per lb		to		7½
Epsom Salts	per lb		to		4½
Ergot, new	per lb	1 30	to	1	35
Ergotine	per oz		to	1	15
Ether, Acetic	per lb		to		82½
Butyric, concentrated	per lb		to	4	00
Butyraceous	per lb		to	1	75
Chloric	per lb		to		87½
concentrated	per lb		to	1	40
Formic	per lb		to	4	00
Sulphuric	per lb	70	to		75
washed	per lb		to		80
concentrated	per lb		to		90
Extr. Jockey Club, Chiris	per lb		to	3	65
Extr. Ess. Bouquet, Chiris	per lb		to	3	75
Extr Banana, superior	per lb		to	1	25
Extr. Orange, superior	per lb		to	1	25
Fluor Spar	per lb		to		16
Flowers, Althea	per lb		to		42
Arnica	per lb	22	to		24
Borrage	per lb		to		95
Chamomile, German	per lb		to		40
Chamomile, Roman, 1867	per lb	36	to		38
Lavender	per lb		to		9
Malva, large	per lb		to		40
small	per lb		to		45

Flowers, Rosemary	per lb		to	70
Tiliae	per lb		to	70
Violet	per lb		to	68
Fusel Oil, purified	per lb		to	2 00
Ferro - Phosphorated Elixir of Calisaya	per doz		to	12 00
Bark, Hazard & Caswell's,	per grs		to	144 00
Gamboge	per lb		to	1 15
Gelatine French Pink	per lb		to	1 45
Gelatine, White French	per lb	85	to	1 00
Cox's	per doz		to	2 25
Ginger, Jamaica, bleached	per lb		to	28
Ginseng	per lb		to	85
Glauber Salts	per lb	3	to	
Glycerine, common	per lb		to	35
concentrated	per lb		to	50
"Bowers"	per lb		to	80
"Price's"	per lb		to	1 00
Glycerole Hypophosphite	per lb		to	1 75
Grains D'Ambrette	per lb		to	60
Paradise	per lb		to	30
Gum Acroides	per lb		to	24
Amber	per lb		to	50
Ammoniac	per lb		to	60
Arabic, Turkey, sorts	per lb		to	55
1st picked, Trieste	per lb		to	95
2d " "	per lb		to	75
3d " "	per lb	55	to	60
Barbary	per lb		to	40
Assafœtida	per lb		to	50
Benzoin, common	per lb		to	65
prime	per lb		to	85
white marbled	per lb		to	95
Copal, Accra	per lb		to	
Benguela	per lb		to	30
Kowrie	per lb		to	45
Damar, Batavia	per lb		to	60
Singapore	per lb		to	55
Elemi, Aromatic	per lb		to	55
Euphorbium	per lb		to	25
Galbanum	per lb		to	1 00
strained	per lb		to	1 25
Gedda	per lb		to	25
Guaiacum	per lb		to	48
strained	per lb		to	50
Kino	per lb		to	50
Mastic	per lb		to	4 25
Myrrh, Turkey, powdered	per lb		to	68
Olibanum	per lb		to	30
tears	per lb		to	40
Sandarac	per lb		to	65
Shellac, Campbell's D. C	per lb		to	50
Garnet	per lb		to	48
No. 2	per lb		to	45
Native	per lb		to	43
Senegal	per lb		to	50
Tragacanth, common	per lb		to	50
flake	per lb	1 30	to	1 50
flaky sorts	per lb		to	60
Harlem Oil, Dutch	per doz		to	50
Hoffman's Anodyne	per lb		to	45
Hydriodate Potash, Atkinson's	per lb		to	5 10
Conrad's	per lb		to	5 00
Hyoscyami Leaves	per lb		to	26
Hypophosphite Ammon	per lb		to	3 50
Iron	per lb		to	8 00
Lime	per lb		to	3 25
Manganese	per oz		to	75
Potash	per lb		to	3 25
Soda	per lb		to	3 25
Iceland Moss	per lb		to	10
Indian Hemp, true	per lb		to	1 00
Insect Powder, true	per lb		to	1 00
Iodine, Resublimed	per lb		to	6 50
Crude, in bulk	per lb		to	6 25
Irish Moss	per lb		to	10
Iron, Alum	per lb		to	1 60
by Hydrogen	per lb		to	2 50
Carb. Proto	per lb		to	45
Precip	per lb		to	25
Citrate and Ammonia	per lb		to	1 40
Magnesia	per lb		to	1 30
Quiniæ	per oz		to	60
Strychnine	per lb	10 00	to	
Hypophosphite	per lb	8 00	to	
Iodide	per lb		to	8 00
Syrup	per lb		to	78
Lactate	per lb		to	3 25
Phosphate, Precipitate	per lb		to	67
Pyrophosphate	per lb		to	1 55
Syrup	per lb		to	65
Sesquichloride	per lb		to	1 45
Sol	per lb		to	60
Sesquinitrate	per lb		to	44
Subsulphate	per lb		to	1 70
Sulphate, pure	per lb		to	9
Exsiccat	per lb		to	17
Sulphuret	per lb		to	31½
Superphosphate Syrup	per lb		to	65
Tannate	per lb		to	6 00
India Ink	per lb		to	1 25
Isinglass, American	per lb		to	1 15
Russian, true	per lb		to	6 50
Juniper Berries	per lb		to	6
Juniper Tar Soap, Hazard & Caswell's	per doz		to	3 50
Kreosote, white	per lb		to	1 15
Lactucarium	per oz		to	75
Lead Acetate, pure	per lb		to	90
Licorice Paste, solid	per lb		to	40
Sicily	per lb		to	30
Calabria	per lb	44	to	
Imitation	per lb		to	37
Barracco	per lb		to	44
P. S	per lb		to	44
Lime, Carbonate, Precipitate	per lb		to	22
Hypophosphite	per lb		to	3 75
Iodide	per lb		to	8 50
Phosphate, Precipitate	per lb		to	40
Sulphite	per lb		to	31
Lime Juice	per gal		to	1 50
Lint, Taylor's	per lb		to	1 80
Lapis Calaminaris	per lb		to	8
Laurel Berries	per lb		to	12
Leaves	per lb		to	12
Liquid Styrax	per lb		to	60
Long Pepper	per lb		to	90
Lunar Caustic, pure	per oz		to	1 30
67 per cent., N. S	per oz		to	90
Lycopodium	per lb		to	60
Magnesia Carbonate	per lb		to	42
Calcined	per lb	95	to	1 20
ponderous	per lb		to	1 80
Citrate	per lb		to	1 75
Sulphite	per lb		to	1 20
Manganese, powdered	per lb		to	8
Saxony	per lb		to	12
Manna, small flake, '68	per lb		to	1 60
large flake, '67	per lb		to	2 25
sorts, new	per lb		to	1 30
Matico Leaves, true	per lb		to	50
Mercury	per lb		to	90
cum Creta	per lb		to	53
Magnesia	per lb		to	1 22
Cyanuret	per lb		to	5 80
Sulphuret	per lb		to	80
Mercurial Ointment (⅓M)	per lb		to	70
(⅓M)	per lb		to	58
Morphia Sulphate	per oz		to	9 25
Acetate	per oz		to	9 25
Muriate	per oz		to	9 25
Valerianate	per oz		to	11 00
Musk, true	per oz		to	16 00
in grain true	per oz		to	32 00
Nux Vomica	per lb		to	14
Oil, Amber, Crude	per lb		to	60
Almonds (Expressed) Allen's	per lb		to	75
Essential, Allen's	per lb		to	22 00
Anise	per lb		to	4 00
Bergamot	per lb	6 00	to	7 00
FF, new crop	per lb		to	6 00
Bergamot, Donner's	per lb		to	7 00
Bergamot,—Sanderson's	per lb		to	7 50
Cade	per lb		to	1 00
Cajeput	per lb		to	2 00
Camphor	per lb		to	1 75
Caraway	per lb		to	2 75
Seed	per lb		to	5 50
Cassia	per lb		to	3 75
Cinnamon, true	per oz		to	1 25
Citronella, prime	per lb		to	2 25
Winter's	per lb		to	2 50
Copaiva	per lb		to	3 00
Croton	per lb		to	3 50
Cubebs	per lb		to	4 00
Cummin	per lb		to	10 00
Fennel	per lb		to	3 00
Geranium	per lb	12 00	to	22 00
Chiris	per lb		to	14 00
Prepared	per lb		to	25 00
Turkish	per lb	14 00	to	18 00
Jessamine	per lb		to	3 50
Juniper	per lb		to	1 20
Berries, true	per lb		to	3 50
Lavender, Garden, forte	per lb		to	1 65
fine	per lb		to	1 85
Flowers, Chiris, No. 1	per lb		to	3 75
Lavender Spike	per lb		to	1 00
Laurel, Expressed	per lb		to	90
Lemon, Donner's	per lb		to	4 50
Lemon,—G. R. & Co's	per lb		to	4 30
—Sanderson's (new)	per lb		to	4 50
Lemongrass,—Winter's	per lb		to	4 00
Mace, Expressed	per lb		to	2 50
Marjoram	per lb		to	1 75
Myrrbane	per lb		to	2 00
Neroli Bigarade	per oz		to	4 75
Chiris	per oz		to	4 75
Petit Grain	per lb		to	23 00
Olive, pure	per gal		to	1 75
Marseilles, quarts	per box		to	5 50
pints	per box		to	6 50
Orange	per lb		to	3 50
Origanum	per lb	75	to	1 40
Patchouly	per oz		to	4 25
Pennyroyal	per lb		to	3 00
Peppermint, pure	per lb		to	3 50
Rhodium	per lb		to	10 00
Rose, Kissaulick	per oz		to	10 00
Rosemary, French	per lb		to	1 75
Trieste	per lb		to	1 15
Chiris	per lb		to	2 25

Oil, Sabine, pure	per lb	to	1 70
Sassafras	per lb	to	1 00
Sesame, Salad, fine	per gallon	to	2 40
Spearmint	per lb	to	4 00
Spike	per lb	to	
Succinum, crude	per lb	to	60
rectified	per lb	60 to	1 25
Tanzy.—"Eastman's"	per lb	to	5 00
Thyme, white, pure	per lb	to	2 75
Valerian	per lb	to	18 00
Wintergreen	per lb	to	4 50
Wintergreen, Van Deusen Bros.	per lb	to	4 50
Wormwood	per lb	to	6 50
Wormseed, Western	per lb	to	2 50
Baltimore	per lb	to	3 25
Black Pepper	per lb	to	1 25
Cognac	per oz	to	3 50
Ergot	per oz	to	20
Opium	per lb	to	18 00
Orange Buds or Apples	per lb	to	18
Curacoa Ribs	per lb	to	88
Otto Rose, pure	per oz	to	10 00
commercial	per oz	to	7 00
Peppers, Zanzibar	per lb	to	35
Phosphorus	per lb	to	1 20
Amorphous	per lb	to	3 25
Piperin	per oz	to	1 50
Podophyllin	per oz	to	75
Poppy Heads	per lb	to	25
Potassa, Acetate	per lb	to	72
Bicarbonate	per lb	to	30
Carbonate	per lb	to	18
Caustic, common	per lb	to	60
white	per lb	to	85
Citrate	per lb	to	1 10
cum Calce	per lb	to	70
Hypophosphite	per lb	to	3 25
Permanganate, ordinary	per lb	to	75
Phosphate	per lb	to	2 75
Prussiate	per lb	to	44
Sulphate	per lb	to	15
Tartrate	per lb	to	1 00
Potassium	per oz	to	3 75
Bromide	per lb	to	1 50
Cyanide, fus	per lb	to	75
gran	per lb	to	1 40
Iodide	per lb	to	5 00
Sulphuret	per lb	to	33
Quinine, Citrate, with Iron	per oz	to	60
Sulphate, American	per oz	to	2 45
French	per oz	to	2 35
Quassia, rasped	per lb	to	7
Red Chalk Fingers	per lb	6½ to	
Red Precipitate	per lb	to	1 10
Resin of Jalap, pure	per lb	to	28 00
Rochelle Salt	per lb	to	58
Roots, Aconite	per lb	to	24
Alkanet	per lb	17 to	
Althea	per lb	to	20
Angelica	per lb	to	30
Calamus	per lb	20 to	60
Colchicum	per lb	to	20
Colombo	per lb	to	20
Culveris	per lb	to	20
Dandelion	per lb	to	28
Galangal	per lb	to	10
Gentian	per lb	to	18
Ginger, Race, African	per lb	to	18
Jamaica, Bleached	per lb	to	28
Golden Seal	per lb	to	80
Hellebore black	per lb	to	16
white, powdered	per lb	to	28
Ipecacuanhæ	per lb	to	2 60
powdered	per lb	to	2 75
Jalap	per lb	to	1 70
powdered	per lb	to	1 90
Licorice	per lb	to	15
Mandrake	per lb	to	15
Orris, Florentine	per lb	to	20
Verona	per lb	to	15
Pink	per lb	to	30
Rhatany	per lb	to	28
Rhubarb, E. I	per lb	2 50 to	4 00
Turkey	per lb	to	24 00
Sarsaparilla, Honduras	per lb	to	54
Mexican	per lb	to	20
Turbeth	per lb	to	60
Valerian, English	per lb	to	50
Dutch	per lb	to	35
German	per lb	26 to	35
Vermont	per lb	to	35
Snake, Virginia	per lb	to	32
Senega	per lb	to	44
Rose Leaves	per lb	to	2 50
Rosemary Leaves	per lb	to	12
Rubigo Ferri	per lb	to	10
Saffron, American, new	per lb	to	2 25
Spanish, true	per lb	to	16 00
Sago, Pearl	per lb	to	12
Salicin	per oz	to	55
Sal Acetoscella	per lb	to	50
Ammoniac	per lb	to	18
Soda, Newcastle	per lb	to	4½
Santonine	per oz	to	1 20
Sassafras Bark	per lb	to	10
Scammony, virg., true	per lb	to	20 00
Seeds, Anise	per lb	to	24
star	per lb	to	60
Canary, Dutch	per bush	to	4 60
Smyrna	per bush	to	4 60
Cardamom, Malabar	per lb	to	4 25
Carui	per lb	to	25
Celery	per lb	to	75
Clover	per lb	to	16
Colchicum	per lb	to	20
Coriander	per lb	to	16
Cummin	per lb	80 to	85
Fennel	per lb	to	18
Fœnugreek	per lb	to	11
Hemp	per bush	2 25 to	2 50
Linseed, American clean	per tierce	to	11 00
rough	per bush	to	2 50
Bombay (gold)	per bush	to	2 50
Calcutta (gold)	per bush	to	2 55
Mustard, brown	per lb	to	14
white	per lb	to	14
Rape	per bush	to	5 00
Timothy	per bush	to	5 00
Worm	per lb	to	28
Seidlitz Mixture	per lb	to	45
Senna, Tinnevelly	per lb	to	25
Alexandria	per lb	to	36
E. I	per lb	to	25
Smalts, Blue	per lb	to	22
Snuff, Lorillard's Maccaboy	per lb	to	78
Coarse Rappee	per lb	to	1 00
Irish High Toast	per lb	to	85
Fresh Scotch	per lb	to	85
Soap, Castile, Mottled	per lb	to	16
White	per lb	to	25
floating	per lb	to	25
Low's Brown Windsor	per grs	to	14 25
Soda Acetate	per lb	to	80
Chlorate	per lb	to	2 05
Chloride, Liquor	per gal	to	45
Citrate	per lb	to	1 15
Hydrosulphate	per lb	to	1 05
Hypophosphite	per lb	to	3 50
Hyposulphite	per lb	to	9
Nitrate, pure	per lb	to	22
Phosphate	per lb	to	31
Pyrophosphate	per lb	to	1 25
Sulphite	per lb	to	32
Ash	per lb	to	4
Sodium	per oz	to	75
Iodide	per oz	to	50
Spirit Ammonia	per lb	to	43
Aromatic	per lb	to	45
Lavender	per lb	to	43
Nitre Dulc	per lb	37 to	40
Rosemary	per lb	to	45
Sponges, Bahama	per lb	to	90
Bathing, Formes	per lb	to	4 00
Coarse Brown	per lb	to	60
Fine, medium	per lb	6 00 to	
Surgeon's	per lb	4 00 to	7 00
Zimoca	per lb	2 00 to	3 00
Cup, Turkey	per lb	20 00 to	30 00
Trieste	per lb	4 50 to	13 00
Fine Toilet, bleached	per lb	12 00 to	15 00
Fine Trieste, small	per lb	4 00 to	4 50
Glove	per lb	to	1 50
Grass	per lb	to	25
Sheep's wool	per lb	1 60 to	
Sur Choix	per lb	to	5 50
Squills	per lb	to	12
St. John's Bread	per lb	to	8
Strontia, Muriate	per lb	to	80
Nitrate	per lb	to	80
Oxalate	per lb	to	1 80
Strychnia, Acetate	per oz	to	3 50
Citrate	per oz	to	70
Nitrate	per oz	to	3 50
Pure, crystallized	per oz	3 00 to	3 25
powdered	per oz	2 75 to	3 00
Sulphate	per oz	to	4 00
Valerianate	per oz	to	5 50
Styrax Calamita	per lb	to	55
Sugar of Lead	per lb	to	84
Sugar of Milk	per lb	to	58
Sulphur Sublime	per lb	6½ to	7
Tamarinds	per lb	to	10
Tannin	per lb	to	2 35
Tapioca, East India, white	per lb	to	11
Pearl	per lb	to	15
Tartar Emetic, powdered	per lb	to	90
crystallized	per lb	to	1 10
Tin Foil, thin	per lb	to	45
French, No. 15	per lb	to	80
Tobacco	per lb	to	40
Tonqua Beans, Para	per lb	to	60
Augustora	per lb	to	80
Uva Ursi, American	per lb	to	12
French	per lb	to	13
Vanilla Beans, Bourbon	per lb	13 00 to	16 00
Mexican	per lb	15 00 to	18 00
Venice Turpentine	per lb	to	30
Veratria	per oz	to	4 25
Vitriol, Blue	per lb	to	14
Green	per lb	2¾ to	3

Vitriol, White	per lb		to	9
Wax, White,—J. I. Elkens	per lb		to	78
No. 2	per lb		to	75
Phillips'	per lb		to	85
Yellow	per lb		to	50
White Wax,—Leonhardt's	per lb		to	90
Ockmid	per lb		to	85
Sun-bleached	per lb		to	76
White Precipitate	per lb		to	1 50
White Pepper	per lb		to	30
Wine, Colchicum Seeds	per lb		to	1 40
Wood Naphtha	per lb		to	95
Wormwood Herb	per lb		to	20
Yellow Bark	per lb		to	30
Dock	per lb		to	25
Zaffre	per lb		to	1 15
Zinc, Acetate	per lb		to	1 25
Chloride	per lb		to	1 80

DYES AND DYESTUFFS.

Aniline Blue	per lb		to	6 75
Red	per lb		to	6 75
Violet	per lb		to	6 75
Annatto	per lb	1 00	to	1 75
Cochineal, Honduras	per lb		to	1 25
Mexican	per lb		to	1 20
Cudbear	per lb	28	to	45
Cutch, Pegue	per lb		to	15
Gambier	per lb		to	7
Indigo, Bengal, fine	per lb		to	3 25
good	per lb	2 50	to	2 75
middling	per lb	2 00	to	2 10
Madras, fine	per lb		to	1 70
ordinary	per lb		to	1 40
Kurpah	per lb		to	
Guatemala	per lb		to	2 00
Caraccas	per lb		to	1 65
Lac Dye, good to fine	per lb	55	to	60
Logwood, Campeachy	per lb		to	2¾
Honduras	per lb		to	2¾
Jamaica	per lb		to	2¾
Laguna	per lb		to	2
St. Domingo	per lb		to	2
Extract	per lb	14	to	18
" in bulk	per lb	14	to	15
Lima Wood (gold)	per bbl		to	70 00
Madder, Dutch	per lb	17	to	
French	per lb		to	21
Nutgalls, Blue, Aleppo	per lb		to	40
Orchille	per lb	30	to	35
Persian Berries	per lb	50	to	55
Safflower	per lb	60	to	65
Sapanwood	per lb		to	15
Turmeric	per lb		to	15
Ultramarine	per lb	28	to	45
Woad	per lb	15	to	16

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials	50	percentage	discount.
German Flint Bottles and vials	30	"	"
Flint Bottles and vials	25	"	"
Furniture Ware	10	"	"
Perfumer's Ware	25	"	"
Chemical Ware	net	"	"
Syringes	10	"	"
Homœopathic vials	10	"	"

NAVAL STORES.

Pitch, City	per bbl		to	4 00
Rosin, Extra Pale	per 280 lbs	8 00	to	
Pale	"	7 00	to	
No. 1	"	5 00	to	
No. 2	"	3 50	to	
Strained	"	3 50	to	
Common	"		to	3 00
Spirits, Turpentine (North Carolina)	per gal		to	50
Turpentine, Soft	per 280 lbs		to	6 00

OILS.

Linseed Oil, American	per gal	to	1 10
English	per gal	to	1 10
Palm Oil	per lb	to	16
Paraffine Lubricating Oil	per gal	to	40
Sperm, Crude	per gal	to	2 10
Sperm, Winter, unbleached	per gal	to	2 20
Lard Oil Prime, City	per gal	to	1 70
Red Oil, City distilled	per gal	to	70
Red Oil, Saponified	per gal	to	78
Whale, Crude	per gal	to	1 15
Whale, Bleached, Winter	per gal	to	1 25

PAINTS (DRY).

Asphaltum, opt	per lb	10	to	12
Barytes, Foreign	per ton		to	45 00
Barytes, American	per lb		to	2
Black Lead	per lb	8	to	12
Black Ivory, drop, fair	per lb	10	to	18
good	per lb	18	to	20
best	per lb	24	to	28
Blue Celestial, good	per lb		to	14
Chinese	per lb		to	1 00
Prussian, fair to best	per lb	35	to	1 00
Ultramarine fair to best	per lb	28	to	45
Chalk, Lump	per lb		to	2¼
China Clay	per lb		to	2½
Chalk	per bbl		to	4 50
Green Paris, fair to best	per lb	35	to	50
Green Chrome, fair to best	per lb	33	to	42
Lamp Black—Coach Painter's—L. Martin & Co.'s.	per lb	28	to	25
Lamp Black, ordinary	per paper	8	to	12
Litharge, powdered, American & English	per lb	11	to	11½
Ochre, Yellow, French, dry	per lb	2½	to	4
Red Venetian	per lb	3½	to	5
Red Indian, fair to best	per lb	11	to	18
Red Lead, American	per lb	11	to	12
English	per lb		to	14
Rose Pink	per lb		to	20
Sienna, American	per lb	7	to	9
Italian, B'nt	per lb	18	to	22
Raw	per lb	15	to	20
Umber, Crude, Turkey	per lb	5	to	7
burnt	per lb	8	to	9
Tieman's Calif. Vermilion	per lb		to	1 00
Pure Carmine	per lb		to	14 00
Soluble Blue	per lb		to	1 25
Vermilion, English, pale	per lb		to	1 10
deep	per lb		to	1 10
American	per lb		to	35
Chinese	per lb		to	1 20
Trieste	per lb		to	1 20
White, China	per lb		to	22
Cremnitz	per lb		to	30
Lead, pure	per lb	13	to	14
good	per lb	9	to	11½
Paris	per lb	3½	to	4
Zinc, American	per lb	10	to	12½
Zinc, French	per lb	14	to	16
Whiting	per lb			3

PAINTS (IN OIL).

Black coach	per lb	28	to	30
Blue, Chinese	per lb	90	to	1 00
Prussian, fair to best	per lb	35	to	80
Brown, Van Dyke, fair to best	per lb	20	to	28
Dryer, Patent, American	per lb	12½	to	14
English	per lb	12½	to	15
Green, Chrome	per lb	18	to	27
Imperial	per lb	15	to	18
Paris	per lb	33	to	42
Verdigris	per lb	25	to	68
Putty, in bladders	per lb		to	5½
in bulk	per lb		to	5
Red Venetian, fair to best	per lb	8	to	16
Sienna, burnt, fair to best	per lb	22	to	35
White Lead, English, B. B.	per lb		to	16
American, pure	per lb	13½	to	14
good	per lb	11	to	12½
fair	per lb	9	to	10
White Zinc, American	per lb	10	to	13
French	per lb	15	to	15¼
Yellow Ochre	per lb	9	to	10
Chrome, fair to best	per lb	16	to	32

SPICES.

Cassia, in mats	per lb		to	67
Cloves	per lb		to	40
Ginger, Race, African	per lb		to	19
Mace	per lb	1 70	to	1 80
Nutmegs, No. 1	per lb		to	1 40
Pepper	per lb		to	38
Pimento, Jamaica,	per lb		to	34

WINDOW GLASS.

American Window—1st, 2d, 3d, and 4th qualities.

6	by	8	to	8	by	10	Per fifty feet	$ 6 25 to 3 75
8	by	11	to	10	by	15	"	6 75 to 4 75
11	by	14	to	12	by	18	"	7 50 to 5 50
13	by	16	to	16	by	24	"	8 50 to 6 00
18	by	22	to	18	by	30	"	10 00 to 7 00
20	by	30	to	24	by	30	"	12 50 to 8 00
24	by	31	to	24	by	36	"	14 00 to 9 00
25	by	36	to	26	by	40	"	16 00 to 10 00
28	by	40	to	30	by	48	"	18 00 to 14 00
24	by	54	to	32	by	56	"	20 50 to 16 00
32	by	58	to	34	by	60	"	24 00 to 18 00
34	by	62	to	40	by	60	"	26 00 to 21 00

The above is subject to a discount of 40 per cent.

French Window—1st, 2d, 3d, and 4th qualities. (Single thick.)

6	by	8	to	8	by	10	Per fifty feet	$ 6 25 to 4 75
18	by	11	to	10	by	15	"	6 75 to 5 00
11	by	14	to	12	by	18	"	7 50 to 5 50
13	by	18	to	16	by	24	"	8 50 to 6 00
28	by	22	to	18	by	30	"	20 00 to 7 00
20	by	30	to	24	by	30	"	12 00 to 8 00
24	by	31	to	24	by	36	"	14 00 to 9 00
25	by	36	to	30	by	48	"	16 00 to 10 00
28	by	40	to	30	by	48 (3 qlts)	"	18 00 to 14 00
34	by	54	to	32	by	56 (3 qlts)	"	20 50 to 16 00
32	by	56	to	36	by	60 (3 qlts)	"	24 00 to 18 00
34	by	52	to	40	by	60 (3 qlts)	"	26 00 to 21 00

Subject to a discount of 40 per cent. English sells at 10 per cent discount of the above rates.

THE CHEMICAL NEWS.
Vol. V. No. 6. American Reprint.

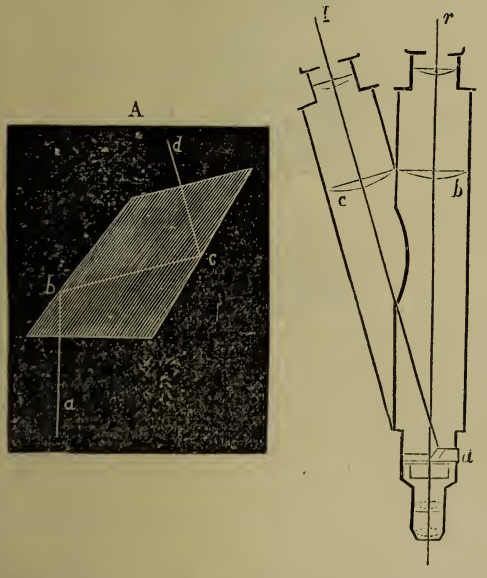
ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Am. Repr., Nov., 1869, page 285.)

A description of the compound achromatic microscope can, at the present time, hardly be considered complete without some mention of binocular instruments. The binocular principle had been applied to opera glasses with great success for many years. More recently the invention of the stereoscope and its great popularity drew increased attention to the subject of binocular vision, but until a few years ago no attempt seems to have been made to adapt the principle to microscopes. Owing to the short focal length of microscopical objectives, the use of two convergent instruments would of course be impracticable; the only resource was to divide the pencil proceeding from the object-glass and convey half to each eye. The earlier attempts resulted

Fig. 11.†



in the production of pseudoscopic instruments; that is, the relative positions of the object viewed were reversed projections, being represented by depressions and the contrary. This was found to be caused by the rays of light being conveyed to the wrong eyes, the right side of the image entering the right eye, and the left the left eye, the effect being that of a wrongly mounted stereoscopic picture. It was found necessary that the right-hand image should be conveyed to the left eye, and *vice versâ*, to produce a stereoscopic effect; this was accomplished by M. Nachet of Paris, and Mr. Wenham by different methods, each having their respective merits. As Mr. Wenham's is most in use in this country, I will briefly describe it. A four-sided prism of peculiar form (Fig. 11, A) is placed in the body of the microscope, just behind the posterior combination of the object-glass (Fig. 11, B, *b*), which, when in position, it half covers. An additional body, *l*, is joined at a slight inclination to the left-hand side of the instrument, and the two bodies are furnished at their upper extremities with draw-tubes, which supply the means of making an adjustment for the varying distance between the eyes of different persons. The image formed by the left-hand half of the objective passes up the straight tube to the right eye without being in any way interfered with by the prism; the right-hand image falls on the prism, is twice reflected, and passes into the left-hand inclined tube, and in this simple manner the crossing of the images from the two sides of the objective is effected, only one-half of the pencil suffering any reflection at all, besides giving the great advantage of instantly converting the instrument into a monocular by simply withdrawing the prism. It is only due to Mr. Wenham to mention that he has, with most praiseworthy liberality, granted free and unconditional use of his valuable invention to the public.

The binocular arrangement of Mr. Wenham cannot be used with advantage with objectives of less than half an inch focal length, but several arrangements have been constructed by which both eyes can be employed in high power observations, the most noteworthy of which has been brought forward by Messrs. Powell and Lealand. This instrument does not produce any stereoscopic effect, but nevertheless greatly diminishes the fatigue of protracted observations. A still more perfect adaptation has been constructed by Mr. Wenham, in which the light in each tube has been more nearly equalized than in preceding instruments.

The stereoscopic binocular offers many advantages over the monocular instrument, not the least of which is the saving of the fatigue to the eyes from which most persons suffer in a greater or less degree when using one eye for observation. Did the binocular arrangement do no more than this it would be a great boon, but it has the valuable property of enabling the observer readily to estimate the amount of elevation and depression of the surface he is viewing, and accurately to determine the relative position as to depth of the various parts of the tissue under observation. The discoveries which we owe to this improvement of the microscope have been numerous and valuable; among the earliest were some interesting observations on the circulating system of the tadpole, by Mr. W. U. Whitney (*Trans. Micros. Soc. Lond.*, vol. x., 1862, p. 1; and vol. xv., p. 43). Several also by the late Richard Beck; among them the re-discovery of the aperture in the fang of the spider figured by Leeuwenhoek (Hoole's English Translation, vol. i., Pl. 2, fig. 19) (*Science Gossip*, 1866, p. 201).

By a slight variation of the form of the prism, Mr. Crouch has succeeded in constructing a microscope which can, by merely shifting the position of the prism, become stereoscopic or pseudoscopic at pleasure. This modification of the binocular will probably be of value in confirming certain doubtful points of structure, by giving a reversal of the parts in relief.

Further particulars respecting the construction of the microscope and the optical principles involved will be found in the "Microscope and its Revelations," by Dr. Carpenter, and "Manual of Natural Philosophy," by Mr. Charles Brooke.

The microscope being a costly instrument, it is necessary that great care should be taken to preserve it from injury. When out of use it should be returned to its

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

† "The Microscope and its Revelations," by W. B. Carpenter, M.D., Figs 19 and 20 (Churchill).

[English Edition, Vol. XX., No. 514, pages 157, 158.]

case or may be conveniently covered with a large shade or bell-glass. The eye-pieces should be carefully cleaned, as dust upon them becomes very apparent. The object-glasses, if kept in their boxes when out of use, will seldom require much cleaning; dust on the object-glass only causes a slight loss of light, but does not make itself visible. The best material for cleaning lenses is a piece of very soft wash-leather from which all dust has been beaten out; it should be kept in a large pill-box when out of use to preserve it from dust and grit, and should on no account be used for any other purpose, such as cleaning the brass-work of the instrument. Should the object-glasses require anything beyond mere dusting, they should be placed in the maker's hands, as they are liable to injury if taken to pieces by inexperienced persons.

The sources of light for the purposes of observation will need a few remarks. When it can be procured, daylight is in every respect to be preferred to artificial sources of illumination, as by it alone can colours be perfectly seen and distinguished, and daylight observations are far less fatiguing than those made by lamplight. Direct sunlight should be avoided, and, if possible, the light taken from a white cloud. But in towns, as the sky is seldom visible, and, moreover, few persons have much time to observe by daylight, it becomes important to seek for a good source of artificial light.

Gas has been used by many microscopists; it has the disadvantage of giving out a large amount of heat, and the quality of the light is inferior to that obtained from most other sources; its sole advantage is its convenience, as it is always ready for use, and requires no trimming, as is the case with lamps.

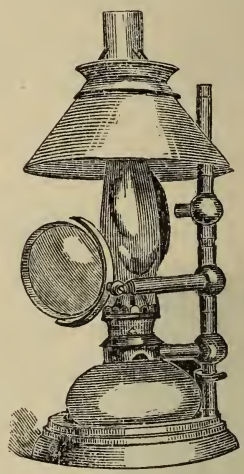
Well constructed lamps burning colza oil give a light of good and pure quality, although not as intense as those presently to be described. The best oil-lamp I have used was obtained from Mr. Pillischer, and was only abandoned for the very intense camphine lamp. Oil-lamps require great care in trimming and cleaning, otherwise they will not burn well.

The mineral oils (paraffin, belmontine, &c.), when of good quality, and consumed in properly constructed lamps, are among the best of the microscopist's means of illumination. The quality of the light is good, and there is very little trouble required in keeping the lamp in good working order. The glasses, as in all lamps, should be kept clean, otherwise much light is lost, and to obtain the best possible effect the lamp should be trimmed each time of using, although it will burn very well two or three times without any attention. The best way of obtaining a good oil is to try small samples from various shops, and when a good one is found keep to its use. The burner exercises a very great influence upon the light, so great that in a series from various makers it would hardly be supposed that they were burning the same oil. The burners of American make supplied by Mr. Collins with the Bockett microscope lamps (Fig. 12), are some of the best that I have met with. This lamp has recently been improved by the adaptation of a metal chimney which is not liable to breakage, and also has the advantage of protecting the eyes of the observer from the light.

The best light of all for those who do not mind the slight amount of trouble attending its use is obtained from the combustion of camphine or highly rectified spirits of turpentine in a small lamp, especially constructed for the purpose by Mr. W. Young. The light is much whiter and more intense than that of any other lamp; owing to this quality the flame can be very much reduced in size, and most of the heat of a large lamp avoided, a matter of importance where the lamp is often placed near and below the face of the observer.

Camphine, when not used quickly, should be kept in small bottles, filled up to the neck, and closely corked, and kept in a cool place—a wine-cellar answers admirably. For the small consumption of the microscope lamp the bottles should not exceed four or five ounces, as the spirit rapidly deteriorates by exposure to the air both from evaporation and the absorption of oxygen, which renders it liable to clog the wick and reduces its illuminating power. The wick should be cut very exactly to a level, far more carefully than would be required for oil or paraffin, the least uneven point rendering the lamp liable to smoke. No more camphine than is likely to be consumed should be placed in the lamp; if there is more than is needed it should be allowed

Fig. 12.



to burn itself out, or be thrown away, and the wick allowed to burn dry, otherwise the lamp is liable to become clogged, and burn badly. Should any part of the lamp become incrusted with a resinous deposit, it must be cleaned with methylated spirit; care should be taken that none of the air passages are obstructed. Although these precautions may seem troublesome, they really are not so to persons willing to acquire the habits of neatness so necessary to those who would make good microscopists; and the slight extra trouble is amply compensated by the superior purity and intensity of the light and its extreme cleanliness, it being perfectly free from greasiness or disagreeable smell. As the lamp is always kept empty it is very convenient for carrying about when it is necessary to make observations away from home.

The illuminating apparatus commonly supplied with microscopes consists of the mirror below the stage, and a condensing lens either attached to the instrument, or, as is to be preferred, on a separate stand. Other apparatus will be described in subsequent chapters.

The mirror is used for illuminating objects by directing light through them from beneath the stage, and is the usual, although not always the best, means of lighting an object, as it is one which we are unaccustomed to, and, without special precautions, is likely to lead into error. The mirror is capable of being moved out of the axis of the instrument, and light may be directed very obliquely upon the object, which is sometimes advantageous.

The condensing lens is used to concentrate light upon the object from above, and, when it can be employed, it is always preferable to commence an observation in this way rather than by means of transmitted light, as it accords more closely with our every-day way of viewing objects: it is not our usual custom to hold up a substance we wish to examine and try to look through it, but we generally allow the light to fall naturally upon it. If a plano-convex lens, or "bull's-eye," be used as a condenser, it is necessary to be careful which side is turned to the source of light, otherwise it may be used in a position causing a great amount of spherical aberration and consequent loss of light. A plano-convex condenser should always have its curved side turned to the source of light when used for concentrating light upon an object. When used for rendering divergent rays, such as those of a lamp, parallel, which is often required when using apparatus hereafter to be described, the bull's-eye should be placed with its flat side to the lamp and at about the distance of its focal length.*

The beginner is recommended to commence his observations by endeavouring to procure a good and brilliant illumination with the condensing lens, looking at any easily procured objects, such as fragments of paper, feathers, sand, &c.; a humming-bird's feather or wing of a butterfly is particularly useful, as either of them presents very different appearances, according to the direction of the illuminating pencil, the iridescent colours of the first and the imbricated structure of the second not being seen unless the light is made to fall in the proper direction. The light should be moved or the object turned round, and the varied appearances carefully noted. This precaution should be adopted with all objects viewed by reflected light.

In commencing observations by transmitted light, the student may profitably examine air-bubbles in water, easily procured by shaking up a little very weak gum-water in a bottle, and also globules of oil in water, of which milk furnishes a good and readily-procured example. A little of each of these should be placed on a separate slide, covered with a thin glass and examined by transmitted light, the air-bubbles with an inch objective; the milk may probably require a $\frac{1}{2}$ or $\frac{1}{4}$.

The leading characteristic of the air-bubble is its broad black margin when examined by transmitted light. If the laws of refraction are considered, it will be evident that a bubble of air in water will act precisely as a double concave lens, Fig. 4, B, and by its dispersive power scatter the rays of light, especially at the part where its power is greatest—the margin. The same effect may be produced, on a large scale, by holding to the light two plano-concave lenses of glass with their hollow sides placed together; this will almost exactly represent the air-bubble in water, differing only in the glass having a greater refractive power than the water in the microscopic slide, and dispersing the light rather more powerfully.

The oil globules of the milk exhibit a brilliant spot of light in their centre when slightly beyond the focus of the microscope; this is owing to their being more refractive than the surrounding medium: their action is that of double convex lenses, Fig. 4, A, and the bright spot is an imperfect image of the source of illumination, which is rendered visible when the focus of the microscope coincides with that of the globule, which will be when the instrument is slightly above the focus for distinct vision of the globule.

These appearances should be carefully studied and remembered, as bubbles of air are among the most frequent of the intrusive substances to be met with during microscopical observations; cells filled with oil and globules of oil are also of frequent occurrence in tissues. Besides these, the student should make himself acquainted with the microscopical appearance of fibres of cotton, wool, flax, &c., hair of cats and other animals, all of which are frequently found in the dust of our apartments, and of course in our microscopical preparations, unless more than ordinary care is taken to prevent their intrusion, so that it is well to know them that they may not be mistaken for characteristic portions of the substance under observation, a not unlikely error on the part of inexperienced observers.

A sample of dust from the walls of an office in the Bank of England, where it had accumulated for more than ten years, consisted of about one-half cotton fibres, probably derived from abrasion of paper; the remainder consisted of fibres of wool and flax in small quantities, and soot and grit; molecular motion was apparent when examined in water with a power of 400 diameters. An interesting paper "On the Microscopical Examination of Dust" was read by Mr. J. B. Dancer before the Literary and Philosophical Society of Manchester, January 26th, 1869.

The subject of the present chapter may be considered rather as mechanical than microscopical; in fact, it relates more to the workshop than to the study. It may, perhaps, seem strange to write about making apparatus and preparing materials in these days when nearly everything can be bought often better and more cheaply than it can be made at home, and when it is not as it was within the memory of many microscopists, who were obliged to cut their glass slides, or, at all events, to order a glazier to make them: but the more dexterous a person is with his fingers the better microscopist he is likely to make. Very often the success of an observation depends upon the observer being able to make some little contrivance to aid his researches, and it is for that purpose that the subject of the mechanics of the microscopical laboratory finds a place here.

The first material that engages the attention is glass. It comes under notice in several forms—the plates of glass upon which objects are mounted, the thin covering glass, and glass tubing. The glass generally used for mounting objects is a description of glass known as patent plate. Crown glass is sometimes used, but patent plate is perhaps the best. It is made from that commonly known by the name of cylinder glass, which is manufactured by the glass being blown, first of all, into a globe, then, by dexterous manipulation on the part of the workman, it is elongated, and a cylinder is formed. This cylinder is ripped up, and put in an annealing oven: it unbends at the slit, and rolls itself out flat. In this state it is known as sheet or flatted glass. The glass then undergoes the same treatment as plate glass. It is ground down and polished, and then it becomes the patent plate. It is a thin glass, with a beautiful surface, so accurately worked that the plates will adhere together if pressed, just as good specimens of ordinary plate.

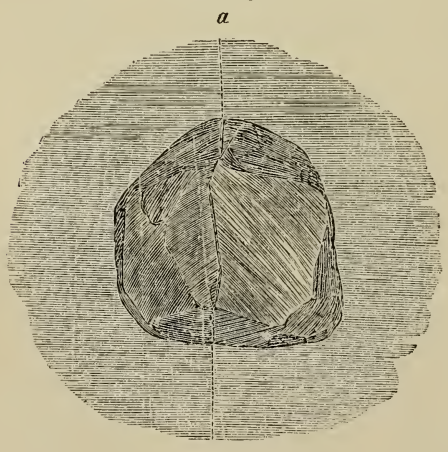
The tool used for cutting glass is the well-known

* Each lecture was followed by a practical demonstration, during which various objects, &c., were examined and processes in manipulation carried on under the superintendence of the lecturer and assistants. Much of the subject-matter of these demonstrations will be incorporated with the text: such portions as cannot be so given will be added at the end of the various chapters.

glazier's diamond. It seems to have nothing in common with ordinary cutting tools: an incision or scratch with a diamond or other instrument, such as a flint or chilled-steel point, will not make the clean fracture we are so familiar with when the cutting diamond is used by a skilled hand. The diamond would seem rather to act by inducing some molecular displacement than by any actual penetrative power that it possesses. This view would seem to be supported by the appearance presented by the glass adjacent to a diamond cut when examined by the microscope with the aid of polarised light, which shows that the glass has been subjected to some kind of strain. Rubies and sapphires, if worked to the form of the natural edges of the diamond crystal, will cut glass, but lose the power when the curved edge wears away. A very interesting paper on the fracture of glass and the action of the diamond, by Mr. F. H. Wenham, will be found in the *Microscopical Transactions* for 1868, p. 105. (See also *Holtzapfel*, "Turning, &c.," vol. i.)

There is some little art in using the cutting diamond: it is not any part of a diamond that will cut. It is very easy, indeed, to scratch with a diamond, but it is only in certain directions that it will make the so-called cut. The Glazier's diamond (Fig. 13), when viewed under the binocular microscope, will be found to exhibit a well-defined and slightly curved edge, *a*, *b*. The diamond is carefully set so that this edge (which is a natural crystalline one) lies parallel with the oblong mounting, and, as the diamond requires to be held in an inclined position to secure a clean cut, the top of the setting is always bevelled to the proper angle. It is allowed a little play horizontally on a pivot, so that, upon placing the diamond in contact with a rule, it will

Fig. 13.



always place itself in the cutting direction, and, by keeping the end of the setting parallel with the glass, it will be in a position for cutting. It is then drawn along; and those who have seen a glazier cut glass will remember the curious noise which accompanies the operation—something between a ringing and a hissing: the sound is very different from a scratch. The glass breaks at the place upon being bent. With a little practice, the cutting of glass will be very easy indeed; but it is not worth while, as a general practice, to cut slides, as they can now be bought at a cheap rate: it is chiefly for exceptional purposes that facilities for cutting glass are of value. Sometimes a piece of glass of extra size or unusual shape is required, and then time is often saved by being able to do the work, instead of waiting until the services of a glazier can be obtained.

The other kind of glass employed in mounting objects is the thin glass for covers. The details of its manufacture are unknown to me. It is remarkable for its extreme brittleness. In cutting, the glazier's diamond is not employed, but a splinter known as the writing diamond. The operation is attended with some difficulty, as the glass is very likely to crack and star under the diamond. This is best prevented by placing the thin glass to be cut on a piece of wet plate-glass, which affords support, and effectually prevents splitting and cracking. As in the case of 3 × 1 slides, it is hardly worth while to cut up squares and circles of thin glass, as it can be easily procured of the opticians already cut into the most useful sizes, or, if required in large quantities, of the wholesale glass warehouses. Of course pieces of unusual sizes and shapes are sometimes required, and then the power of cutting becomes of value.

The writing diamond is also used for making marks and writing on glass. Some persons write the names of their objects on the glass instead of on a label: it has the advantage of durability, but is not so legible as an inscription on paper.

Sometimes it is required to drill a hole in a piece of glass. This is a matter of no very difficult accomplishment. A good hard drill, if it is kept moistened with turpentine, will, with a small amount of patience and labour, eventually work its way through a piece of glass. Care should be taken that the glass rests upon a cork bed, or something soft, but yet firm, to give it sufficient support, or it may break just before the point of the drill makes its way through. Perhaps the best plan is to begin on the other side when the drill has penetrated about half-way. Some persons are of opinion that dilute sulphuric acid, in the proportion of eight parts of water to one of acid, serves for moistening the drill better than turpentine. Of course the fluid used is the reverse of a lubricant: if oil were employed, the drill would not cut. The drills are best hardened by heating to redness and cooling suddenly with strong sulphuric acid. The edge requires working up from time to time upon an Arkansas stone, with oil. In drilling a thick piece of glass, the drill may require setting once or twice during the process; but I have never had any difficulty in drilling through a thick piece of plate.

The rough, sharp edges left on glass after cutting with the diamond may be removed by grinding with fine emery and water upon a smooth paving stone or thick plate of zinc: the glass-cutters usually employ emery upon a lap or horizontal wheel.

For many cutting processes, tools made of corundum and shellac are very useful; this composition, in the form of wheels, files, hones, &c., of several degrees of fineness, can be obtained of Mr. D. Lyon, 43, S. John's Square, Clerkenwell, E.C. These tools, especially the wheels, are employed by dentists, in cutting and shaping the semi-vitrified porcelain used in the manufacture of artificial teeth. The use of the corundum composition in this country is comparatively recent, although it has been employed for centuries by the native jewellers of India.

Corundum is a crystalline mineral, identical, or nearly so, in composition with the sapphire, ruby,

topaz, and amethyst, equally hard, but wanting in transparency and lustre. Emery is nearly similar, but occurs in a granular form, and does not cut so well, although there are many purposes for which it is more serviceable than the harder corundum.

These tools must be plentifully supplied with water when in use, as, unless kept cool, they soon lose their shape, which would be the case if used dry, as they would rapidly heat and melt with the friction of rasping and grinding a hard substance.

Glass plates may be smoothed, and even rounded at the edges, with the greatest ease, with a corundum file, and almost as quickly as brass could be filed. A tapering tool is useful for enlarging a hole drilled in glass; and the hones serve for grinding sections of substances too hard for the ordinary stones. As the material becomes better known, many other uses will, no doubt, be found for it.

Glass is frequently used by the microscopists in another form, that of tube. It is chiefly employed in making the dipping tubes, with which objects such as free swimming animals and deposits in water are taken up, and for the pointed tubes, or pipettes, with which small portions of fluids are removed and deposited where they may be needed. The manufacture of these bent tubes, or pipettes, is not a matter of difficulty. The processes of drawing glass tube to points, and bending, are very frequent in the laboratory. The best source of heat is obtained from the Bunsen burner, which gives a very large flame without smoke and of great heating power by the consumption of a mixture of air and coal gas. It can be obtained of the chemical instrument makers for a very small sum; a spirit lamp, however, will answer the purpose tolerably well if the wick is a large one. A piece of glass tube, in which it is intended to make a bend, should be heated to a slight redness, and then carefully and slowly bent to the required angle. If an attempt is made to bend a tube suddenly, it will produce a choke, or contraction, in the bend. It is also necessary to heat a considerable length of tube. Pieces of glass tube are very easily detached, by making a notch on them with the edge of a file, and they are then sure to break straight across; any length of glass tube can be cut off in this way. The process most frequently required to be performed by the microscopist is the drawing tubes out into pointed ends for pipettes. To effect this, heat the tube in the flame; when the tube has become sufficiently soft, it can be drawn out to any length and fineness you please. The rough edge at the cut ends of tubing may be taken off by heating the ends in the flame, which will melt the edges and leave them rounded. This rounding of the edges is, perhaps, effected more rapidly by using a blowpipe, which facilitates the fusion of the glass. Sometimes a pipette curved as well as pointed is required; there are many purposes for which it is extremely useful. This is easily made by a little variation of the other process; while it is being drawn out, give it a skilful bend at the proper moment. Always keep tubes of glass revolving while they are being heated, and do not heat them more than is absolutely necessary, as, when the tube is made very hot, it is extremely pliable, and likely to lose its shape. With a little ingenuity a number of useful things may be made out of glass tube. A variety of these pipettes will be found useful, and they are rather expensive to buy.

Glass, whether in the form of slides or thin glass, always requires cleaning. The best cleaning fluid is methylated spirit, which, as it is not subject to duty, and can be obtained cheaply, may be made free use of for this and nearly all the operations of the microscopist in which strong alcohol is required. Care must, however, be taken to obtain pure methylated spirit, and not what is commonly known as "methylated finish," which contains a small portion of shellac in solution, and is quite useless for all microscopical and laboratory purposes, and which is not unfrequently sold when methylated spirit is enquired for. I am indebted to the Rev. J. B. Reade for the history of this adulteration. Formerly, methylated alcohol was allowed to be sold without a license; but certain persons, finding that it was cheap, and not being particular about the flavour of methylic ether, used it for making grog. This fact coming to the knowledge of the excise authorities, its sale by unlicensed dealers was prohibited, unless containing shellac in solution, a mixture which would not spoil it for its chief use, that of varnish making, while, upon mixture with water, the gum would be precipitated, making a very disagreeable turbid compound. There is no difficulty in obtaining pure methylated alcohol in large towns, where one or more licensed dealers are generally to be found. It can be obtained perfectly pure, either in large or small quantities, of Messrs. Jackson and Townson, Bishopsgate Street, and of most other dealers in chemicals. It should not leave any residue upon evaporation, or become turbid when mixed with water; any spirit having these defects should not be used for microscopical purposes.

Great care should be taken that the cloths used for cleaning glass be perfectly free from soap or dirt, otherwise they will leave the surface of the slide covered with striæ. Old linen, or cotton cloths, are to be preferred to new ones; they should, before use, be boiled in water and common washing soda, to remove all soap left from former washings. They are then to be washed several times in clean water, until all trace of the soda is removed, and then dried, but not ironed, as the rough fluffy condition they will be left in is extremely favourable for cleaning glass. After the spirit is cleaned off with the cloth, any fibres that may be left from the cloth should be removed with a soft wash-leather.

Thin cover glass is treated in a similar manner, but, on account of its excessive brittleness, requires great care in cleaning. After a little practice, it is quite easy to rub it with the cloth and leather between the thumb and finger; but, should any difficulty be experienced, which may be the case with the thinnest kinds, it will be found that it can be rubbed with considerable force, without injury, between two discs of wood covered with wash-leather. The great thing in rubbing a brittle substance is to support it well behind: this is the whole secret of cleaning thin glass between the finger and thumb.

For joining together pieces of glass, and for attaching metal to glass, the cement known as marine glue is usually employed. It consists of india-rubber, shellac, and coal naphtha, combined in various proportions, according to the purpose for which it is intended to be used. It is, I believe, difficult to make in small quantities; but there is no trouble in obtaining it, as it is sold by most microscope makers. As this cement will only adhere to hot surfaces, it is necessary to have some means of applying a steady heat to the pieces of glass, &c., to be joined; and as this cannot be done by means of the unprotected flame of a lamp, a hot-plate is generally employed. This can be obtained, ready

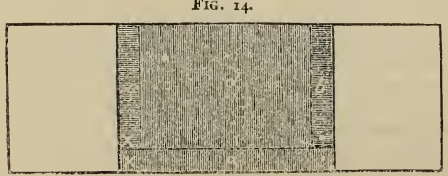
i

made, of the opticians; but a piece of thick brass plate, about 6 or 7 inches long and 2 inches wide, placed upon one of the rings of a retort stand, will answer admirably; it can be heated by means of a spirit lamp or gas flame placed underneath. Supposing, for example, it is required to attach a ring of glass or metal to a glass slide, to form a cell for an object to be mounted in. The glass slide is placed upon the hot-plate, first of all, at the part most distant from the lamp, to avoid breaking it by too sudden heating, and then moved gradually to the hotter part; the ring is also heated on the plate, a piece of marine glue is held on the point of a needle in a handle, or other convenient holder, and rubbed on the heated glass over the surface to which the ring is to be attached. When a sufficient portion of glue is melted on the glass, care being taken to heat the glue sufficiently for free working, while overheating amounting to boiling is to be avoided, the heated ring is then lifted on with a pair of forceps, which, for this and all other purposes where they are likely to be made hot, should be of brass, or else an old pair of steel forceps, which are to be kept for such uses. The ring is then to be turned round backwards and forwards on the glass, to spread the cement equally, and then removed from the hot-plate and pressed on a piece of wood, to expel superfluous glue, and allowed a little time to set; when set, but still warm, the greater part of the cement can be scraped off with a blunt knife, a process much more difficult if it is allowed to become quite cold. A number of cells can be attached and roughly cleaned at one time, the plate next required being heated while the one cemented is being cleaned off. When quite cold, the slides can be thoroughly cleaned with a piece of rag and a free use of methylated spirit; they should then be rubbed bright with a clean cloth. Some persons use liquor potassæ for cleaning off superfluous marine glue; it does this very effectually, but not so rapidly as strong alcohol, and the operation is a rather unpleasant one, as the alkaline solution first softens, and then removes the skin from the fingers.

The adhesion of marine glue, and other cements, to glass surfaces, is much improved by grinding, which gives the cement a better hold than it would have on a polished surface, although marine glue will adhere well to polished glass, provided the surface is free from grease, which may be insured by a cleaning with methylated spirit. The adhesion of two pieces of glass cemented with marine glue is so perfect that they generally break in any place rather than at the joint.

A very useful trough for viewing objects in fluid can be made with a slight amount of trouble. Cut in half an ordinary 3 × 1 slide (Fig. 14, shaded portion in centre). From this cut off the strip *a*, then the pieces *b* and *c*, and reject the centre piece, *d*. Before cutting, it is well to mark the adjacent edges with ink, as indicated in the figure, to prevent any mistake in putting them together afterwards. The three pieces, *a*, *b*, and

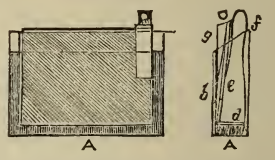
Fig. 14.



c are to be cemented with marine glue on the middle of a slide, and, as the cut portions, if replaced as directed, fit each other accurately, there is no occasion for grinding. The trough is completed by fastening an oblong piece of thin cover-glass on the upper surface. For this purpose it is better not to use marine glue, as the cover frequently requires removal, as, from its thinness, it is liable to be broken in cleaning. It can be best secured by the use of the following, known as "electrical cement," from its having been used to fasten various portions of electrical apparatus together:—Melt together five parts rosin, one part bees'-wax, one part red-ochre, two parts Canada balsam; mix well, and pour into pill-boxes of convenient size. This cement is most conveniently used with a miniature soldering bit, which is rendered more comfortable to use by its being balanced with a plug of lead in the handle. With a little practice, a very neat joint can be made. The cement is also useful for many other purposes, of which notice will be taken in the proper place.

Larger troughs, having sides of plate-glass, can be made by those who will take the necessary trouble. In this case, the surfaces to be cemented must be ac-

Fig. 15.



curately ground. Such vessels are very useful in looking over the results of pond-hunting with a low power for the purpose of selecting such objects as may be required for more detailed observation. The troughs, of various shapes, can be purchased at most opticians.

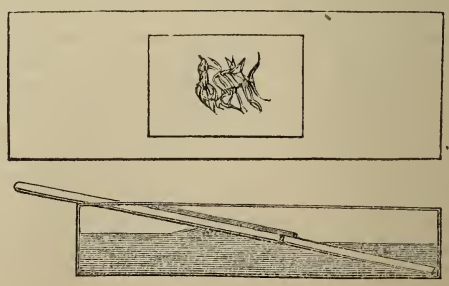
The form represented in Fig. 15 is particularly convenient, as by means of the whalebone spring, *f*, and the wedge, *g*, the space between the front glass, *b*, of the trough and the inclined plate, *c*, is capable of adjustment, so that an object can, when desired, be kept close to the front glass. These parts can be removed when a greater depth of water is required for larger objects.

A simple and useful contrivance, to be used as a growing-slide, has been described by Mr. C. J. Muller (*Monthly Microscopical Journal*, vol. i., p. 174). The object of a growing-slide is to keep alive any minute water-plant or animal, the development of which it is wished to observe. Many plans have been devised for this purpose, but none equal in simplicity or efficiency that now to be described.

An ordinary 3 × 1 slide (Fig. 16, A) is pierced with a

Fig. 16.

A



B

minute hole at about 3-10ths of an inch from the centre

on one side. When an object under investigation is put upon it immersed in water, the thin glass cover is so placed as to include this hole, which should be near its margin. When it is desired to keep the specimen moist while off the stage of the microscope, the slide is placed in a small flat trough (B) in an oblique position, object uppermost, with one end (that nearest the hole) resting against the bottom of the vessel on one side, and the other resting upon the edge of it. Sufficient water is put into the vessel to admit of the liquid reaching within a ¼ or ½ an inch of the glass cover on the uppermost side, when it will be found that the water on the under side reaches beyond the centre of the slide, and consequently beyond the hole with which it is pierced. In this state, the object will remain moist so long as the trough contains a sufficient quantity of water. When required to be placed on the stage of the microscope, the water is easily wiped off the slide, without any disturbance of the object.

Mr. Muller's original trough was made of tin-plate, but, as this material is liable to rust when long in use, Mr. F. W. Gay has had them made of pewter of an improved form, which has proved an effectual remedy for this defect. Thus constructed, they are to be obtained of Mr. C. Baker, Holborn.

The process of attaching cells to plates of glass has been given; but nothing has been said about the material of the rings forming the cells. When required of some considerable depth, rings made of slices cut from thick glass tubing answer admirably. If square or oblong cells are required, they can be cut from tubes of suitable form. Very useful cells are now made by Mr. Collins of pure tin of various thicknesses, from that of thin writing-paper up to that of a thick tube cell: several sizes can also be procured in each thickness. Tin is not acted upon by any of the fluids used in preserving microscopical objects, and has the advantage of being much cheaper than glass, and at the same time equally efficient. Cells of unusual form can readily be cut from the sheet-tin with a penknife or pair of scissors, and circles can readily be punched. The adhesion of the cover-glass is improved, and the process of mounting in fluid much facilitated, by grinding the upper surface of the cell after it is attached to the slide with water upon a Water-of-Ayr stone, as suggested by Dr. Carpenter. This gives a beautiful surface, and ensures the perfect fit of the cover, and renders the closing of the cell a matter of greater certainty than it would be if the natural surface of the metal were used.

Some very useful aids to the examination of microscopical objects, and which can readily be made by the exercise of the smallest amount of mechanical ingenuity, are described by Mr. S. J. McIntire, in the *Transactions of the Quekett Microscopical Club*, vol. i. p. 69. One of these is of such general application that it will be well to describe it. A piece of sound sheet cork, about 2 in. by 3½, or other convenient size, and of a thickness suited to the purpose for which it is intended, is perforated with an oval or circular hole; this may easily be cut with an oval or sharp chisel, and the edges finished with a file. The cork is placed between two pieces of glass of similar size, the lower one being covered with a few layers of pink blotting paper, and the whole contrivance kept together with two india-rubber rings. The cell so constructed is used for keeping alive small insects that inhabit damp situations, such as *Podurœ*. The moisture is readily supplied by dipping the end of the slide into water, which is absorbed and retained by the blotting paper. The proper food of the insect can be placed in the cell. By the aid of this simple contrivance, Mr. McIntire has been enabled to make some most interesting observations on the habits of the *Podurœ*, which have been kept living in these cells for many months. This plan admits of modification to suit the object under observation. In the author's researches on the blow-fly, it was necessary to use thin glass, and to have the means of viewing the object on either side; this was accomplished by cutting a rectangular hole in a suitable piece of cork, placing the thin glass on either side, and securing it by bending on its edges strips of the sheet tin used for making cells which had been inserted in the cork, which effectually fastened the glass in a somewhat similar manner to that by which a stone is set by jewellers, and readily permitted its removal when required.

Among the tools employed by the microscopist, none are more generally in request than needles of various sizes and forms. They are frequently required of various curvatures; this bending can readily be performed by the microscopist himself. If a needle is heated to redness in the flame of a spirit-lamp, and allowed to cool, it can easily be bent or twisted into any required form. Steel so treated, if heated again to redness and suddenly cooled in water, becomes excessively hard and brittle; in this condition it is capable of scratching glass, but is too fragile for dissecting instruments. The right temper for the dissecting needles is obtained by heating and cooling in tallow or oil; this, with needles, may be readily done in a common tallow (not composite or paraffin) candle. While the needle is soft, it may, by the exercise of a little dexterity, be hammered out so as to form a small knife or lancet, which can then be hardened so as to take a cutting edge; many useful instruments can also be made out of small pieces of steel. Needles and cutting instruments are best sharpened upon a very hard, white stone, known at the tool shops as Arkansas oil-stone; it cuts very rapidly, and gives an extremely fine edge. Scissors, when blunt, may readily be sharpened on the oil-stone, by opening the blades and rubbing them on the stone, holding them nearly upright. The burr produced by this operation need not be ground off, as it is soon removed when the blades are worked together; the screw is to be tightened if required. For delicate dissections, the steadiest cutting instrument is a kind of scissors, made almost exactly like a minute pair of sheep shears, and known as the microtome; in use, it feels very much as if the fingers were extended and armed with cutting edges. There is hardly any other cutting instrument so much under the control of the operator.

The best handles for needles and other small instruments are made of cedar pen-holders, into which the needle, with the eye broken off, is inserted with a pair of pliers. Very convenient handles, which have the advantage of allowing the needles to be removed at pleasure, are to be purchased at fancy warehouses; they are used for holding crochet hooks; they are improved by the removal of the ivory handle, and the substitution of one made of a cedar pen-holder, which can easily be attached to the metal socket with electrical cement, and will be found to be lighter and more pleasant in use.

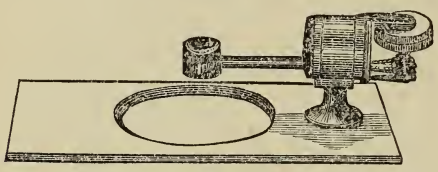
The processes connected with the preparation and preservation of microscopical objects have always occupied a considerable space in nearly every work on the use of the instrument. The subject is one of general interest, and the importance of being able to

preserve specimens for future reference can scarcely be overrated.

The simplest of these processes, and also the oldest, is that known as "dry-mounting."

The objects suitable for mounting dry are those which can be preserved in air and are capable of being dried without injury to their structure. The ways of mounting are extremely numerous, and are principally means of protection from the great enemies of all natural history preparations—damp and dust. One of the oldest ways of mounting objects was upon discs punched from a compound sheet of card and wash-leather, through which a pin was run for convenience of holding in the stage forceps and keeping in a cork-bottomed drawer. This plan of mounting was abandoned when the lieberkuhn fell into disuse, but it has since been revived in a new form by the late Richard Beck, who invented a very ingenious instrument for

Fig. 17.



holding the small discs of metal and turning them into any required position. This is an extremely useful piece of apparatus, as it is often required to turn an object into several positions for the thorough examination of its structure. So perfectly is this accomplished, that five out of the six sides of a cube may be examined by means of the revolving disc-holder. This instrument has supplied a want created by the introduction of the binocular microscope, as the greater focal depth and stereoscopic effect given by it has rendered advantageous frequent changes of the position of objects, for which this contrivance most effectually provides. For the keeping of the discs from the influence of dust and damp, he contrived a close-fitting screw-box, having suitable arrangements for the reception of twenty-four discs.

Great use has also been made by some observers of open cells. These consist of a hole bored in a 3 × 1 slide of wood, with a piece of card-board glued to the bottom, the objects being fastened with a little gum. This answers very well with objects not liable to injury from exposure, such as shells; but, for most purposes, it is necessary to close up the object, and this, in many instances, is done in a manner very detrimental to its preservation. Wherever paper and paste or gum are used, various fungi and confervæ are nearly sure to make their appearance, unless special precautions, such as saturating the paper with, and mixing in the gum, a small quantity of corrosive sublimate. The microscopical fungi are doubtless interesting plants, but, when they grow over valuable preparations, we feel them to be a nuisance, and decidedly in the way.

Some microscopists, avoiding the use of paste, gum, and paper for securing the cover to the slide, have made use of varnishes of several kinds. These generally have the defect, if thin, of running in between the glass and cover and spoiling the object, and, if thickened with a solid substance, such as lamp-black or vermillion, of becoming porous after a time. Some of the fluid medium of the varnish, also, is liable, in drying, to rise in vapour within the cell, and condense on the cover, interfering with the distinct view of the object. The vapour of turpentine or naphtha, however, is in no way otherwise detrimental, as it tends rather to the preservation than the destruction of tissues.

The electrical cement previously described (Chemical News, vol. xx., p. 181. *Am. Repr., Dec.*, 1869, *p.* 326) is free from this defect, and furnishes a means of rapidly mounting objects either with or without a cell. If the object is very thin and flat, it may be placed upon a slide, and a thin glass cover put over it. Both having been carefully cleaned, one of the spring clips made of wire and cork (which are to be procured of most opticians) can be used to hold the cover in place while the cement is being run round it with the little brass bit. The bit should not be made too hot, or it will not hold the cement. After the cover has been fastened down, the rough cement can be smoothed by passing over it a clean bit heated rather more than is required for laying on the cement. The bit is easily cleaned by wiping while hot upon a piece of blotting-paper. The first attempts, no doubt, will be far from elegant in appearance; but, after a little practice, great neatness may be attained. This process is also available for attaching the cover to cells of metal or glass, which must be used with dry-mounted objects whenever their thickness is such as to require it. This mode was formerly much employed, but was abandoned on account of the brittleness of the cement. This may be remedied by varnishing, when the cement has become hard, with gold-size, which is remarkable for the tenacity with which it adheres to glass and its toughness and non-liability to crack. Respecting the properties of this varnish, more will be said in the chapters relating to fluid-mounting. This system of compound cementing answers perfectly; the electrical cement having, in the first instance, no tendency to run in, and the gold-size effectually keeping it from separating from the glass. If the natural red colour of the electrical cement is objected to, a black finish can best be obtained by the use of lamp-black as prepared for water-colour painting. The best form is that in tubes. A little of this is pressed from the tube, and, if too thick, a small quantity of water added. With this the varnished surface is thickly painted, and, when dry, a few coats of gold-size will keep it from being washed off. The result is a dense, lustrous black, very superior in effect and durability to that produced by a black varnish. This finish is equally available for fluid and balsam mountings.

If the object cannot be kept in its place by the pressure of the cover glass, it will require fastening. If the object will bear a slight amount of heat, a small spot of electrical cement may be placed on the glass, melted by holding over a lamp, and, while soft, the object fixed. Or the thick varnish composed of shellac and wood-naphtha, sold at most varnish-shops as liquid glue or "patent knotting varnish," will be found useful for this and other purposes to be mentioned hereafter. Care must be taken to allow the naphtha time to evaporate, or its vapour will obscure the cover. While this drying is taking place, the slide may be turned face downwards over a large pill-box, or the cover put on, and kept in place with a spot or two of electrical cement, deferring the completion until the varnish has dried.

It is not necessary to employ any kind of black background for opaque objects, the best background being that of the dark-well beneath the stage, formed by bringing round that part of the diaphragm-plate which has no hole, and so closing up the aperture. If a black

patch is used, it prevents advantage being taken of various kinds of illumination from beneath, which are often of great service, while the mounting on clear glass is in no way detrimental to the view of an object lighted from above.

It is necessary that the object to be mounted should be perfectly dry before it is placed in the cell, otherwise moisture will, sooner or later, make itself apparent.

Most objects can be dried by the application of a moderate heat. If wrapped up in a piece of paper, and placed inside the fender, in an hour or so they will be found to be effectually dried. A Seidlitz-powder box answers extremely well for this kind of drying: it can be still more effectually accomplished by means of the well-known hot-water oven.

There are cases, however, where heat is inadmissible, especially with delicate tissues. The desiccation of these is best accomplished in a vacuum. The substance to be dried is placed under the receiver of an air-pump; the air is exhausted, and, under these conditions, it will give off vapour at a much lower temperature than under ordinary atmospheric pressure. It is only necessary to provide some means of absorbing the watery vapour as fast as it is given off—such as concentrated sulphuric acid or dry lime.

Another, and very effectual mode of drying delicate tissues without heat, is the process described in the Chemical News (vol. xiii., p. 122, *Eng. Ed.*), translated from *Zeitsch. für Anal. Chemie.* This process, which is quite new so far as its application to microscopical purposes is concerned, consists in immersing the substance to be dried in ether in the presence of dry chloride of calcium. The apparatus employed is simple, consisting of a wide-mouthed stoppered-bottle, at the bottom of which is placed some chloride of calcium. A slice from the bowl of a tobacco-pipe forms a support for a Berlin crucible and cover, in which the substance to be dried is placed. The whole is then covered with ether (the methylated answers very well for the purpose), and the mouth of the bottle closed. The ether absorbs water from the tissue, which is again absorbed by the chloride of calcium, and the process goes on without attention until the chloride of calcium ceases to absorb. The results, as far as at present ascertained, have been very satisfactory. Cellular tissue (fresh potatoe) has been dried without any contraction. Flies' heads have contracted less than by drying in air; the eyes were in very perfect condition, and gave good results upon a section being cut; the striation on the muscular fibre was perfectly preserved. A small spider, treated by this process, was dried without any shrinking of the abdomen. Those substances which are injuriously acted upon by ether cannot, of course, be dried by this process; but it is evidently a very valuable addition to the microscopist's resources.

When the object is removed from the drying apparatus, the ether dries off in a few seconds. If it is required to preserve the object in balsam, it can either be mounted at once, wet, with ether, or transferred to benzole or turpentine.

In the old days of microscopic manipulation, no means was known of preserving objects but that of mounting them dry. The usual plan was to mount about six objects in an ivory slide, between discs of mica, secured with a brass ring: thin glass was unknown at that time. Mounting in Canada-balsam was, after this, hailed as a very great improvement. Whether the idea was suggested or not by insects preserved in amber there are no means of ascertaining. Very often ideas are suggested by natural occurrences, and it would seem likely that some attempt might be made to imitate these specimens of Nature's mounting. Gum and various varnishes were tried, until, at last, Canada balsam was found to succeed.

Canada balsam may be considered as a natural varnish. It is one of the substances known as oleoresins, and is, according to the "Micrographic Dictionary," the product of *Pinus Balsamea*, although, possibly, it may be obtained from more species of the *Coniferæ* than one: something nearly similar is found in every pine-wood—the turpentine exuding from many of the trees. Canada balsam, like some other varnishes, possesses a power of drying more or less readily according to circumstances. It dries more quickly at a moderate heat than otherwise; is readily soluble in ether, turpentine, and benzole; and possesses the advantage of being highly refractive—nearly as much so as glass, thereby rendering the view of the edges of objects clearer when examined by transmitted light, by diminishing the diffraction—that power which light seems to have of going round a corner under certain circumstances, and which causes objects, under high powers, to show ill-defined margins when viewed in air. Canada balsam is also capable of soaking into tissues, and rendering them much more transparent than they would otherwise be. A much clearer view of the interior of semi-opaque objects, and, frequently, of objects that are too dense to transmit any light, can be obtained by its means than possibly could be without it. But, while it has the advantage of rendering tissues very transparent, and, at the same time, preserving them in an undoubtedly permanent manner, it is sometimes liable to render them almost invisible by inducing an excessive transparency; it is, also, applicable only to those substances that can be dried without injury. This, of course, prohibits its use with a very large class of tissues, the minute details of many animal and vegetable structures being obliterated by drying, either by ordinary desiccative processes, or the absorption of their water by means of strong alcohol;—a process which frequently induces great contraction in a substance treated with it, but which is sometimes taken advantage of when it is required to harden a soft tissue.

The process of mounting in Canada balsam is not a very difficult one. The chief obstacles are the presence of damp and air. A few air-bubbles in a preparation are of little consequence; but, if the preparation should be mounted at all damp, it will almost invariably fail. Damp makes itself known by a kind of fog surrounding the object.

If the object to be mounted can be dried on the slide, the mounting is extremely easy. Place upon it a drop of Canada balsam; warm gently over the lamp chimney until it runs, but do not let it boil; then place the cover glass on with the forceps, letting one edge touch first and bringing the cover down gradually, so as to expel any floating air-bubbles with the surplus balsam. Should there be any doubt about the penetration of the balsam, the object may advantageously be moistened with turpentine, or, still better, camphine, if it is to be procured. Objects especially liable to retain air should be prepared by a prolonged soaking in turpentine or benzole; and, in obstinate cases, the air-pump may be used with advantage to aid the saturation with the fluid. Small air-bubbles in a preparation need not be a source of anxiety, as they speedily disappear by absorption.

Sometimes the object may be placed upon the slide, the cover clipped down, and some balsam placed at the edge, which is then melted, and allowed to run in by capillary attraction. This plan has the advantage of causing little or no disturbance in the position of an object, and should always be used, if there is any tendency to curl upon the application of heat.

In some cases, the presence of air within a tissue is an advantage instead of a detriment. The lacunæ and canaliculi in sections of bone, and the tracheal-tubes of insects are much better shown when they are, as it were, injected with air. To retain the air, the treatment must be the reverse of that described. The balsam must be the thickest that can be procured, and the mounting done cold, or with the application of the smallest available amount of heat.

The surplus balsam around the edges of the cover will require to be cleaned off; but this must not be attempted until it has become hard and firm. The hardening of the balsam may be much accelerated by the application of heat. The inside of a fender is a very convenient place for drying balsam-mounted slides. A drying apparatus for effecting this more quickly is described by Mr. D. E. Goddard, in the *Transactions of the Microscopical Society of London*, January, 1864, p. 45.

The simplest way of removing the surplus balsam is to make it very hard, and then wet the slide, and scrape away the balsam with a wet knife. It comes off very readily, and leaves the slide so clean that it can be easily finished with a rag and a little methylated spirit. Where the balsam is not very hard, it is better to scrape away as much as possible with a hot knife, and remove the remainder with alcohol, being very careful not to disturb the cover. The knife for scraping the slide should be softened by heating to redness and allowing it to cool, or it will scratch the glass.

The forceps and needles may be cleaned from balsam by heating in a spirit-lamp, and wiping with rag or blotting-paper. The forceps should be common brass ones, as steel would soon be spoiled, and the needles kept for this particular purpose, as they are useless for any other. Balsam may be removed from the fingers by a free use of methylated spirit.

Canada balsam is best preserved for use in the collapsible tin-tubes used for containing oil-colours. As already mentioned, air is largely absorbed by balsam; indeed, most varnishes dry quite as much by the absorption of oxygen as by evaporation. The advantage of the tube as a receptacle is that the balsam is kept quite close to the top of the tube, and no air allowed to remain there, so the balsam may be preserved in a perfectly fluid state for a long period. Balsam has been kept for two years in these tubes, and been as limpid as when the tube was filled; while, in bottles, the balsam rapidly hardens, and becomes useless if long kept. The tubes have also the advantage of cleanliness in use: the supply is obtained by squeezing out the quantity required, the use of a dipper, an endless source of dirt and introduction of foreign substances, being dispensed with. Should a little balsam ooze out around the screw-cap, it can be scraped away with a hot knife. These tubes also form convenient receptacles for varnishes which are liable to injury by being exposed to the air—such as gold-size. They do not answer for varnishes made with naphtha or spirit, as these varnishes dry entirely by evaporation, and soon fasten down the cap.

Solutions of balsam in various media have been much used by some microscopists. They have the advantage of allowing the mounting of an object to be effected without the employment of heat, a great desideratum in many cases. Chloroform has been the medium hitherto employed for dissolving the balsam, which is previously exposed to a slow heat, until it is dried into a hard, resinous mass. It has been found, however, that objects mounted in this solution have frequently become cloudy, and that the solution, if kept for a considerable period, becomes turbid. Dr. Bastian recommends the use of benzole as a solvent, on the ground of its greater stability. He has made great use of the solution as a medium for making preparations of nervous tissue. A detailed account of his processes will be found in the *Monthly Microscopical Journal*, vol. i., p. 94.

The solution of balsam and benzole is most conveniently kept in a wide-mouthed bottle, with a ground cap instead of a stopper, which will allow a small pipette to be kept in the bottle. Should the fluid become too thick from evaporation, a little more benzole may be added.

Besides the use of balsam as a mounting medium, it is useful as a cement for a special set of purposes. The microscopist who makes the osseous tissues, rocks, or hard substances in general his particular study, will often require thin sections.

The preparation of a bone section will serve very well as an example of section-cutting, and polishing in general. It is required to make a very thin section of a recent bone, polished on both sides, to be mounted dry. The bone is to be cut into thin slices with a watch-spring saw. A level surface is then to be made on one side, by grinding down with water on a piece of blue-stone, or Water-of-Ayr. If the slice is very rough, time may be saved by using a file in the first instance, and finishing on the stone. The fingers may be protected from the action of the stone by bedding the rough section in a piece of cork.

The bone slices are to be cemented with Canada balsam, by their ground sides, to pieces of thick plate-glass; 1½ inches by ¾ of an inch is a convenient size for general use. The chief art consists in using the balsam of the right degree of hardness. A drop of balsam is to be placed on one of the slips, boiled on the hot plate, and allowed to cool. If, when cold, it is just capable of receiving a slight impression of the thumb-nail when pressed hard, it will do. If too soft, it must be heated again, and allowed to cool, and the process repeated, if necessary, until the right degree is obtained. If the balsam is not hardened sufficiently, it will clog the stone in the subsequent process; and, if too hard, it is liable to chip off along with the partially-finished section during the grinding. The piece of bone, cemented in its balsam bed, is to be ground down with water until the surface is levelled. It is then to be polished, so that no scratches appear upon it when examined under the microscope. This is done with putty-powder (oxide of tin, and not in any way connected with glazier's putty), used with water upon a wash-leather strop. When the polishing is completed, the section is to be removed from the glass, which can be done by dropping it into a bottle of benzole, which will dissolve the hardened balsam, and release the section in a few moments. A wide-mouthed stoppered bottle is convenient for this purpose, and the pieces of plate-glass are cut of the small size recommended, in order that they may be easily placed in and removed from the bottle. The half-finished section is now to be cemented to another balsam-bed, and ground down un-

til it is sufficiently thin. With practice, 1-500th of an inch may be attained with a tough substance like bone. The author has approached this thickness even with fossil ganoid scales from the Weald clay. At first, it is well not to attempt too thin a section, and to practise on some material of which a large supply can be obtained. When ground sufficiently thin, the second surface is to be polished, and then detached as before, and afterwards washed in clean benzole, to remove all traces of balsam. The finished sections, when the benzole has dried off, are to be mounted dry by one of the usual processes.

Sections to be mounted in balsam will not require to be polished, as the balsam fills up, and, by its refractive power, apparently obliterates the scratches left by the grindstone. Other hard substances are treated in a nearly similar manner. Fossil bones and teeth, from their extreme brittleness, will require greater care in grinding, and, from their dark colour, must often be mounted in balsam, instead of dry. This is also necessary when they have a tendency to disintegrate. For very hard substances, such as teeth, the Arkansas stone would be of great service; but, unfortunately, it does not cut well when used with water, and, if oil is employed, the balsam is softened. A process devised by Dr. Christopher Johnstone about ten years ago, and published in *Silliman's Journal*, gives a process by which an oil-stone can be employed. The cement used is isinglass jelly, made with alcohol. Use is made of thin paper, as a guard against grinding away the section—an accident of frequent occurrence with beginners. The grinding is performed upon an Arkansas stone, with oil, and hot water is used to detach the section. The grease can be extracted with benzole. A detailed account of the process is given in the *Journal of the Quekett Microscopical Club*, 1869, p. 201. Accounts of the mode of cutting rock-sections, by J. B. Jordan, will be found in the same journal, p. 186, and, by D. Forbes, F.R.S., in the *Monthly Microscopical Journal*, vol. i., p. 240. The process of cutting sections of still harder substances, such as gems, is described by Mr. H. C. Sorby in the *Monthly Microscopical Journal*, vol. i., p. 220. Grindstones and polishing powders of various kinds can be obtained at the better class of tool shops, as Holtzapffel's, Buck's, Fenn's, &c.

Although it is the usual custom to cover slides containing dry and balsam mounted objects with paper, it is preferable to leave them without. A balsam-mounted preparation, well cleaned, and mounted on a piece of good patent plate with polished edges, is far neater than when covered with paper, which too often only serves to conceal an inferior quality of glass.

(To be continued.)

ON THE

DETERMINATION OF CRYSTALLISED SUGAR.

BY JAMES BELL, ESQ.

Two processes for the determination of crystallised sugar have been proposed, one by M. Dumas, and the other by M. Payen. Both methods are based on the insolubility of crystallised sugar in alcohol saturated with refined white sugar, while inverted and uncrystallised sugars are supposed to be soluble therein.

These two processes, while differing in many important particulars, are essentially the same in the method followed in liberating the crystallised sugar, which consists in mechanically washing out, by simple agitation, the inverted and uncrystallised portion. This method of operation may be adapted for the analysis of superior qualities of sugar, but it is not applicable to low descriptions, such as "jaggery" and "concrete," or to mixtures of sugar and treacle.

In the analysis of "jaggery" and concrete," &c., simple agitation in the test liquor is not sufficient to dissolve out, and remove the whole of the inverted and uncrystallised sugars, and liberate the crystallised portion. When the proportion of inverted and uncrystallised sugars present is tolerably large, the sample possesses a considerable degree of tenacity, and, it is not practicable, by simple agitation, to reduce it into that minutely divided state which is essential to admit of the solvent power of the test liquor being brought into full action; and in practice, in order to effect a complete disintegration of the sugar, it is necessary to operate in a mortar, and to gently rub the sample in the test liquor with a pestle.

The alcohol employed in both Dumas's and Payen's processes is of a strength of 85°, or a little under 50 over proof strength, and, prior to saturation, there is added to the alcohol five per cent of acetic acid, for the purpose of decomposing and dissolving any salts of lime, &c., that may be present.

Before submitting the sample to the action of the test liquor, M. Payen removes the "2 or 3 per cent" of moisture it contains by "absolute alcohol." It is obvious that this could not be done with samples containing large percentages of treacle, such as those to which the process hereafter described is applicable, as the "absolute alcohol" could not abstract the water from them, on account of their viscidity, and even if it were possible for it to do so, the reduction in strength would be so considerable that the alcohol would have a very appreciable solvent action.

The strength of the alcohol has a very important influence upon the accuracy of the result, and, while it is desirable to keep the strength as high as possible, that the alcohol may be readily saturated with a small quantity of crystallised sugar, and that a slight reduction in strength will not materially increase its solvent power, it is, on the other hand, essential that the alcohol should be of such a strength that the proportion of the test liquor used for washing the sample will be sufficient to dissolve the whole of the inverted and uncrystallised sugars present.

Alcohol, at the higher strengths, has a very limited solvent power for sugar; but its power for dissolving the sugar increases in a greater ratio than its reduction in strength. For example, at a temperature of 60° Fahr., 100 grains of alcohol by measure of the respective strengths of 62·6, 55·7, and 49·6 over proof dissolve 0·52, 1·34, and 2·94 grains of crystallised sugar respectively. It will thus be seen that, from 62·6 to 55·7 over proof, a reduction in strength of 6·9°, the solvent power of the alcohol is increased by only 0·82 of a grain, or 0·12 of a grain for each degree of reduction in strength, while from 55·7 to 49·6 over proof, a reduction in strength of 6·1°, the solvent alcohol is increased 1·60 grains, or 0·26 of a grain for each degree of reduction, being more than double the ratio of the increase from 62·6 to 55·7 over proof.

In like manner, the solvent power of alcohol for inverted sugar increases with its reduction in strength, but not in an increasing ratio, as in the case of crystallised sugar; on the contrary, the ratio of increase appears to be a diminishing one.

It is necessary to bear these facts in mind in select-

ing alcohol of the most suitable strength for preparing the test liquor. If the alcohol be of a very high strength, the result will show a higher percentage of crystallised sugar than is known to be present; but, on the other hand, if the alcohol used be of a very low strength, there will not only be considerable difficulty in fully saturating it with cane-sugar, but the result will be a much less proportion of crystallised sugar than there should be.

This may be illustrated by the following results obtained from experiments, made upon the same mixture of refined sugar and treacle, with test liquors prepared from alcohol at each of the strengths specified.

	Percentage of crystallised sugar.
1. Alcohol of 40 over proof gave	49·20
2. " 56 " "	54·49
3. " 63 " "	64·70

The result obtained in No. 2, by alcohol of 56 over proof strength, is within a few tenths of the quantity of crystallised sugar known to be present. The large excess in No. 3 is doubtless due to the very limited solubility of inverted and uncrystallised sugars in alcohol of that strength, and the consequent difficulty of dissolving the whole of these sugars in a given number of washings, and thus liberating the crystallised portion. In No. 1 there is a considerable deficiency, which is probably due to the water in the sample having increased the solvent power of the alcohol at that strength in a greater ratio than in the other cases at the higher strengths. The additional quantity of crystallised sugar, however, which the reduced test liquor dissolves, is not, as a rule, in proportion to the reduction which the quantity of moisture in the sugar would make in the strength of the alcohol, a circumstance which is due to the fact that the time the test liquor and the sugar are in contact is too short to allow the former to become completely saturated.

After making a variety of experiments, it soon became obvious that the most suitable strength of alcohol to be used for preparing the test liquor lay between 50 and 56 over proof; but that it could not be absolutely affirmed that alcohol of any particular strength was applicable to the analysis of all description of sugar, ranging from the finer qualities down to molasses.

To ascertain the relative value of alcohol at the strengths of 56 and 50 over proof for preparing the test liquor, a mixture was made, consisting of 60 parts of purified white sugar and 40 parts of treacle; and experiments were made on the mixture with saturated alcohol at each of the strengths named, with the following results:—

	Percentage of crystallised sugar.
Alcohol of 56 over proof gave	59·12
" " 50 " "	57·72

Thus, with alcohol of a strength of 56 over proof, there was a loss of 0·88 of crystallised sugar; but, with the alcohol of 50 over proof, the loss amounted to 2·28 grains, or nearly 2½ per cent more than in the case of the alcohol of the higher strength.

The test in this case was very rigid, and, upon this ground, as well as from a slight loss which must inevitably occur in manipulation, the loss of the 0·88 of crystallised sugar with the alcohol of 56 over proof strength may be accounted for. With refined sugar, it is not only difficult to obtain an intimate and uniform mixture of the crushed crystals and treacle, but the crystals remain exposed, as it were, to the immediate action of the first portion of the test liquor, which acquires increased solvent power from the additional moisture which it takes up from the sugar.

The sample of treacle employed in the preparation of the mixture was found to contain 3·35 per cent of salts and other impurities insoluble in the test liquors; and, in calculating the results, an allowance was made for the proportion of insoluble matter contained in the quantity of treacle used in the experiments.

To determine whether a test liquor prepared from alcohol of a strength of 56 over proof would give uniform results with mixtures of crystallised and inverted sugars in all proportions, mixtures were made of treacle and raw sugar, varying from 10 to 90 per cent of each; and the several mixtures were submitted to careful analysis, and the same conditions observed in every instance. Three analyses were made of each mixture, and also of the raw sugar, and a mean of the results taken.

The raw sugar used was of medium quality, and gave 84·69 per cent of crystallised sugar. The treacle employed was the same as that used in the experiments referred to above; and, in each instance, the proper allowance was made for the proportion of salts and other impurities insoluble in the test liquor.

The mean results of the analyses made of the respective mixtures were as follows:—

	Percentage of crystallised sugar by calculation.	Percentage of crystallised sugar by experiment.	Loss.
90 parts of sugar and 10 of treacle	76·22	75·80	0·42
			Gain.
80 " " 20 "	67·75	67 84	0·09
70 " " 30 "	59·21	59·71	0·43
60 " " 40 "	50·81	51·44	0·63
50 " " 50 "	42·34	43·65	1·31
40 " " 60 "	33·87	36·01	2·14
30 " " 70 "	25·40	28·01	2 61

From the results of the experiments, it will be seen that, as the percentage of treacle is increased (the percentage of moisture being also thereby proportionately increased), the residue, contrary to what might have been expected, indicates a small but gradually-increasing excess over the percentage of crystallised sugar known to be present. This cannot be due to the salts and other impurities in the treacle which are insoluble in the test liquor, for they, as before stated, have already been allowed for. It is highly probable that it is caused by the increasing viscidity of the mixtures and the consequent difficulty of the alcohol, limited in quantity, and approaching nearer and nearer to its saturating point for inverted and crystallised sugars, in effecting the liberation of the crystallised portion.

The results obtained in the analysis of the mixtures containing 80 and 90 per cent of treacle respectively were considerably in excess of the quantity of crystallised sugar present; and it was obvious that the test liquor was inapplicable to the analysis of mixtures containing so large proportions of treacle.

The results accord very well with the theoretical percentages of crystallised sugar in the mixtures down to 50 per cent, but, from this point, the results are not so satisfactory as could be wished.

In the analysis of samples of sugar or mixtures of

sugar and treacle in which the proportion of inverted and uncrystallised sugars amounts to upwards of 50 per cent, a test liquor prepared with alcohol of a slightly lower strength than 56 over proof is more suitable, and gives more accurate results; in fact, by gradually reducing the strength of the alcohol, and employing a fresh test liquor as the scale is descended, practically accurate results may be obtained down to the lowest mixture, consisting of 90 parts of treacle to 10 of sugar.

The mode in which the analyses were conducted may be shortly described. To alcohol of the proper strength, excess of finely-powdered purified white sugar was added, and the mixture was agitated for two or three days, and, as required for use, the clear saturated liquid was drawn off. 100 grains of the sample were then gently rubbed in a mortar with 200 fluid grains of the saturated alcohol, and the washings thrown upon a filter previously counterpoised with another filter. The operation of washing was repeated nine times, with the like quantity of fluid grains, the sugar in the mortar being gradually transferred to the filter, so that, when the 2000 grains of the test liquor were used, the whole of the sugar had been transferred to the filter. The counterpoised filter and that containing the crystallised sugar were then dried in a water-bath, and the difference in the weights, after allowing for the salts, &c., present in the treacle, and insoluble in the test-liquor, gave the percentage of crystallised sugar in the sample.

My best thanks are due to Messrs. Helm and Stokes for the valuable assistance which they rendered me in making the experiments connected with this investigation.

ON THE ACETIC DERIVATIVES OF HYDROCARBONACEOUS SUBSTANCES.

BY MM. SCHUTZENBERGER AND NAUDIN.

Acetic anhydride reacts easily upon many immediate organic principles, playing the part of polyatomic alcohols. The total transformation of bodies into acetic derivatives is thus quickly effected, the degree of substitution varying according to the temperature and the quantity of the anhydride. Here are the results of my experiments.

Acetic Celluloses.—The cellulose (Swedish paper or cotton) was heated to 180° in a closed vessel with six or eight times its weight of acetic anhydride. It dissolved into a thick syrup, which, when poured into water, precipitated white flakes of triacetic cellulose—

$$C_6H_7(C_2H_3O)_3O_5,$$

insoluble in water, alcohol, or ether; soluble in concentrated acetic acid; easily saponifiable by alkalies, with regeneration of cellulose. Whatever the duration of the heating process or the excess of anhydride employed, no higher limit was reached. Cellulose is, then, a triatomic alcohol—

$$\left.\begin{matrix} C_6H_7O_2 \\ H_3 \end{matrix}\right\} O_3.$$

On employing but two parts of anhydride, and heating to only 150°, the cotton swelled without dissolving, by reason of the simultaneous production of diacetic and monoacetic ethers, which could not be separated.

Starch and Dextrine.—Starch, when heated to 140° with excess of acetic anhydride, swelled greatly without dissolving. The mass, when washed with water, yielded a white, amorphous substance insoluble in water, alcohol, ether, and acetic acid; not turned blue by iodine, and saponifiable by caustic alkalies, with regeneration of starch, turning blue by iodine. It represents triacetic starch $C_6H_7(C_2H_3O)_3O_5$. If the mixture of starch and acetic acid be heated to 160°, the swelled mass will dissolve, yielding an amber syrup. This, when poured into water, precipitates a white, amorphous matter, insoluble in water, alcohol, and ether, but soluble in glacial acetic acid. It is easily saponified by alkalies, with separation of dextrine. Its composition is the same as the preceding, and represents triacetic dextrine obtained directly by the action of the anhydride upon dextrine. The degree of substitution of the third order cannot be passed; those inferior were not examined, on account of the difficulty of distinguishing them. Starch and dextrine act, therefore, as triatomic alcohols.

Glycogene.—Glycogene, when heated at 155° with excess of acetic acid, swells without dissolving. The mass, washed in water, gives an amorphous, white product, insoluble in water (even warm), and in alcohol, ether, and acetic acid. It is saponified by alkalies, with regeneration of glycogene. It represents the maximum of saturation, and is triatomic—$C_6H_7(C_2H_3O)_3O_5$.

Gum Arabic.—This substance, when heated with about two parts of acetic anhydride to 150° for some hours, swells without dissolving. The mass, washed first with boiling water and then with alcohol, leaves an amorphous white powder, insoluble in boiling water, and saponified by alkalies, with regeneration of soluble arabin. It represents diacetic arabin, $C_6H_8(C_2H_3O)_2O_5$. By employing an excess of 6 to 8 parts of acetic anhydride, and heating to 180° for five or six hours, a triacetic derivative is obtained, similar in its properties to the preceding one: this is the highest degree of substitution.

Inuline.—This yields, under the same conditions, a saturated, triacetic derivative, soluble in water, of a bitter taste, and melting, at about 110°, into a syrup which solidifies into a vitreous, transparent, and colourless mass. It is easily saponified by alkalies, with regeneration of a white body, insoluble in water, and which melts below 100°. Thus, cellulose and its isomers of the formula $C_6H_{10}O_5$ all give saturated derivatives of the third degree, easily distinguishable from each other by their character of solubility and the nature of the products generated by saponification.

Acetic Derivatives of Sugar.—The action of acetic anhydride on sugar is vigorous: the reaction begins at the instant when the acid boils, and ends of its own accord in a few moments, with great development of heat. The sugar was heated for twenty-four hours at 170° with large excess of anhydride. Alkalies could not here be used for decomposition on account of their ulterior action upon sugar, but it was easily effected by water only at 160°.

Acetic Glucose.—One part of dry glucose, heated to the boiling point of the acetic anhydride with 2½ parts of the latter, in an open vessel, gives a lively reaction, ending in a few moments. The product, when suitably purified, is solid, colourless, and of a bitter taste. It is soluble in water, alcohol, ether, and acetic acid, and melts below 100°. Its analysis corresponds with the formula for diacetic glucose, $C_6H_{10}(C_2H_3O)_2O_6$. This substance, when again heated to 140° with about twice its weight of anhydride, yields a second solid derivative, distinguished from the first by its slight solubility in pure water. It dissolves in water containing acetic

acid, in alcohol, and ether, and represents triacetic glucose. This latter, maintained at 160° for twenty-four hours with a large excess of anhydride, changes into a saturated product very similar to the preceding, but differing by its insolubility in water charged with acetic acid. The acetic liquid, poured into water, yields a viscous precipitate, which is washed with water, again dissolved in alcohol containing bone-black, filtered, and evaporated to dryness. Its composition, which is ascertained by combustion and estimation of the acetyle, is that of tetracetic glucose, wanting a demi-molecule of water, and answers to the formula $C_{12}H_{14}(C_2H_3O)_8O_{11}$. The more simple formula, $C_6H_6(C_2H_3O)_4O_5$, may, perhaps, be employed, but it does not tally so well with the results of the analysis. Under these conditions, glucose undergoes a partial dehydratation. Cane-sugar yields, under similar circumstances, a saturated derivative, undistinguished in character or composition from the preceding. (The rotatory power was not studied.)

Lactine, heated to 140° with acetic acid, dissolves entirely. The liquid, when poured into water, yields a viscous precipitate, which quickly becomes powdery. Acetic lactine softens at about 52°; its composition corresponds with the formula $C_{12}H_{14}(C_2H_3O)_8O_{11}$, or $C_6H_6(C_2H_3O)_4O_5$.—*Comptes Rendus.*

ON THE

OXIDATION OF PHOSPHORUS

AND THE

QUANTITY OF PHOSPHORIC ACID EXCRETED BY THE KIDNEYS IN CONNECTION WITH ATMOSPHERIC CONDITIONS.*

BY J. MOFFAT, M.D., F.R.A.S., F.G.S.

From results deduced from observations on the luminosity of phosphorus in connection with atmospheric conditions for a period of six years, it appears that periods of phosphorescence and ozone periods commence, continue, and terminate under the same atmospheric conditions; that phosphoric ozone is formed only when phosphorus is luminous, and that increase of temperature and low atmospheric pressure are favourable to luminosity, while low temperature and high atmospheric pressure are unfavourable to it.

While the readings of the barometer are increasing and the wind is veering towards the N. points of the compass, phosphorescence diminishes in brilliancy and ozone in quantity; and, while the polar current continues, the barometer attains its maximum, the wind veers from N. to E., phosphorus becomes non-luminous, and ozone disappears. If, when the wind has veered to the E., the barometer readings begin to decrease, the wind sets in from points by S., phosphorus becomes luminous, and ozone appears; and, while the south or equatorial current continues, the barometer readings fall to a minimum, the wind veers from S. to W. points, phosphorescence becomes brilliant, and ozone is in maximum quantity. Liquid and gaseous bodies, when in contact with phosphorus in a non-luminous state, become phosphorated, and they, under suitable conditions, become phosphorescent and ozonised, the temperature at which phosphorescence takes place varying with the pressure of the atmosphere.

As venous blood contains phosphorus (phosphorated fat), which, in coming in contact with the oxygen of the air during respiration, is converted into phosphoric acid (the blood, perhaps, being ozonised at the same time), and combines with the alkalies and earths in the *liquor sanguinis*, and forms phosphates of soda, magnesia, and lime, it appeared to me not unreasonable to suppose that the quantity of phosphorus oxidated and phosphates formed in the system, and eliminated from it through the kidneys, is in some degree determined by the pressure and temperature of the atmosphere, and the state of the weather generally.

With a view to ascertain the quantity of phosphoric acid excreted by the kidneys, I tested the urine of a healthy man daily for twelve months. The quantity of urine evacuated in twenty-four hours was measured daily, and the quantity of phosphoric acid in one ounce of it ascertained. The man was of abstemious habits; his food seldom varied in kind or quantity. It consisted of tea, bread-and-butter, eggs, animal food, rice, oatmeal, and milk. The two articles in excess were bread and milk; of the latter he took at least 3 pints daily. The readings of the barometer and thermometer, the quantity of atmospheric ozone, and the direction of the wind, were recorded daily. The results were deduced monthly, and tabulated as below.

Table I.

Showing the Mean Daily Quantity of Phosphoric Acid Excreted by the Kidneys when—

The barometer was					Temperature was		Ozone was		Phosphorus was		The wind was			
Increasing.	Decreasing.	Above 30 in.	Above 29 in., below 30 in.	Above 28 in., below 29 in.	Increasing.	Decreasing.	Present.	Absent.	Luminous.	Non-luminous.	N. to E.	E. to S.	S. to W.	W. to N.
grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.	grs.
58·8	62·8	53·6	57·5	67·5	62·4	61·4	62·0	56·0	60·0	57·0	56·8	59·5	62·0	61·4

From these results, then, it would appear that the maximum quantity of phosphoric acid excreted from, and in all probability formed in, the system occurs with the conditions of the equatorial or south and ozoniferous current of the atmosphere, and that the minimum quantity occurs with the conditions of the polar or north and non-ozoniferous current. The results of the observations for each month were similar to those in the table, with the exception of March and May. In March, there were 2 grains more of daily mean with increasing than with decreasing readings of the barometer; and, in May, the quantities were equal for both sets of readings. The range of the barometer, for March and May, was 1·247 in. only; while, for August and November, the range was 1·532 in.; and the difference in the quantities of phosphoric acid excreted was a daily mean of 12 grains more with decreasing than increasing readings. When the range of the barometer for the month is above 1·5 in., the difference in the two sets of readings is 6·8 grains more with decreasing than increasing readings; and, when the range is less than 1·5 in., the mean difference between the two sets of readings is 3·4 grains more only for decreasing than increasing readings.

During the months from October to February (both inclusive), that is, during the months in which the temperature of the air is owing more to atmospheric than solar influence, a piece of phosphorus was kept in a dark cellar. It was examined daily, and the quantity

* Read before the British Association, Exeter Meeting, Section B.

consumed or oxidised was ascertained monthly. The results are given in the following table:—

Table II.

Showing that, when the Mean Monthly Reading of the Barometer was—

Between	The quantity of phosphorus oxidised was	The mean daily quantity of ozone was	The No. of azone days was	The mean daily quantity of phosphoric acid excreted was
in.	grs.			grs.
29·0 and 29·5	41·3	2	18	62·5
29·5 " 30·0	20·0	1	8	55·6

From this, it would appear that the amount of phosphorus oxidised in the air and the amount oxidised within us depends upon similar atmospheric conditions. The readings of the barometer which lead to the issuing of cautionary (Admiral Fitzroy's) telegrams are, of course, decreasing.

I have observed that 94 per cent of the telegrams are accompanied by the commencement of periods of phosphorescence. Atmospheric ozone invariably appears or increases in quantity with them. The mean daily quantity of phosphoric acid excreted by the kidneys on the day before the telegrams is 65·3 grains; and, on the day of it, 63·9 grains; giving a mean of 64·6 grains, which is 3½ grains daily above the mean.

The diseases which accompany the meteorological changes which appear to lead to the foregoing results I leave for future discussion.

Hawarden, July, 1869.

ON THE

SOLVENT TREATMENT OF URIC ACID CALCULUS

AND THE

QUANTITATIVE DETERMINATION OF URIC ACID IN URINE. *

BY THE REV. W. V. HARCOURT.

When the British Association met at Manchester in 1861, Dr. Roberts, Physician to the Royal Infirmary of that city, communicated a paper respecting "The Power of Strong and Weak Solutions of the Alkaline Carbonates on Uric Acid Calculi," † in which he showed the fallacy of the experiments supposed to have proved their inefficacy in a report formerly made to the French Academy by MM. Gay Lussac and Pelouze.

Dr. Roberts found that solutions of the carbonated alkalies containing more than 120 grains of the salt in a pint of water arrested their own action by forming an insoluble crust of biurate on the calculus, and that the maximum of solvent power lay in solutions which contain 50 or 60 grains in the pint. At this strength, no incrustation was formed when the carbonate of potash was employed; and 21·4 grains per cent of the weight of the calculus were removed by a flow over it of 6 pints in twenty-four hours. The carbonate of soda followed the same general course, with inferior efficacy.

In 1865, Dr. Roberts communicated to the Royal Medical and Chirurgical Society of London‡ a paper in which he showed, by a series of well-devised experiments, how this discovery might be applied, with a reasonable prospect of advantage, to medical practice; and laid, for the first time, a scientific basis for attempts hitherto empirical and contradictory at dissolving the stone. The most remarkable of these experiments was that in which he passed the urine of a patient who was taking citrate of potash at the rate of 40 grains in 5 ounces of water every two hours over a fragment of uric calculus, and, by this process, reduced it in twelve hours from 180·5 to 174 grains, or at the rate, in twenty-four hours, of 13 grains.

In July, 1868, I was made aware, by an eminent surgeon, Mr. Spencer Wells, of the presence of a stone in the bladder, one diameter of which appeared to measure 1½ inches; and I was advised by Mr. Wells (and by Sir H. Thompson, who confirmed his opinion as to the size of the stone), to aim at preventing its enlargement by such doses of citrate of potash as might keep the urine in a state approaching neutrality. In conversation with my excellent friend, the late Mr. Hodgson, who, when surgeon to the Birmingham Hospital, had had great experience in this complaint, I learned that he had met with so much success in the application of an empirical medicine of much celebrity, manufactured in that neighbourhood, and consisting of carbonates of potash, that, in any case of uric acid calculus, he would advise the experiment of its administration.

Mr. Wells afterwards drew my attention to the experiments of Dr. Roberts, which appeared so satisfactory that I determined to make trial of his method of treatment, and to ascertain, if possible, by chemical analysis, the excess of uric acid above the normal quantity contained in the urine which it might be considered as removing from the calculus.

I felt the great importance of the inquiry, and had the advantage of more than ordinary leisure, a long familiarity with chemistry, a well-furnished laboratory, and an assistant in executing the experiments on whose accuracy I could fully rely.*

I will now proceed to lay before the Section a short abstract of the chief results which I have obtained from an unintermitted course of careful experiments on all the urine voided during the past twelve months, some of which will be found of value to future experimenters, though, from causes which I shall describe, they have not realised all my expectations. If, as I had supposed, there had been any known chemical method of determining, with a near approach to accuracy, the amount of uric acid in urine, then the quantities of that acid which Dr. Roberts had found to be removed from calculi out of the body were abundantly sufficient to be ascertained by analysis, on the supposition that the same process went on in the bladder under the treatment recommended by him. I had scarcely, however, commenced my course of experiments before I became convinced of the fallibility of the methods in use for separating uric acid; and the experiments which I have to describe will place that fallibility in a strong point of view.

The method first employed was the ordinary one of adding 5 per cent of hydrochloric acid, allowing the mixture to stand forty-eight hours, and then, after decantation, collecting the uric acid on a small filter, washing it with distilled water, and drying it at 212° F. till it ceased to lose weight. The first seven determinations, from the 20th of August, 1868, to the 26th, inclusive, were made each day on the urine of the preceding

* Read before the British Association, Exeter meeting, Section B.

† "Report of the British Association, Manchester, 1861," p. 90.

‡ *Medico-Chirurgical Transactions*, vol. xlviii., p. 89.

* My assistant, Mr. W. P. Horn, learned, in Sir Benjamin Brodie's School of Chemistry, in Oxford, those habits of precision in manipulating and accuracy in observing which are essential to chemical experiments.

twenty-four hours, in a neutral or slightly alkaline state, brought to that state by doses of from 120 to 165 grains of citrate of potash. The quantities of uric acid obtained varied from 11·08 to 8·43 grains. In the subsequent daily determinations, down to the 5th of September, acid reactions were interpolated, due to the use of smaller alkaline doses, which lowered, proportionably, the amount of uric acid obtained; and, when no alkali had been taken for two days, and the urine was, in consequence, strongly acid, the quantity of uric acid found was only 2·35 grains.

From this time commenced a course of large quantities of citrate of potash, amounting, during fourteen days, to 315 grains in twenty-four hours, taken in a state of effervescence, in doses of 45 grains, dissolved in 3 fluid ounces of water. For ten of these days, the hydrochloric acid was used to precipitate the uric acid; and the determination of this gave from 11·95 to 6·00 grains. In every case but the last, the whole urine of the twenty-four hours had been used; but, in the last, half was treated with hydrochloric acid, and the other half with the same proportion of nitric acid: that treated with the former acid gave 6·42 grains, whilst that with the nitric acid gave only 1·97 grains. On the following day, half the urine was treated by Lehmann's process, and gave 6·40 grains; half with nitric acid and acetic acid, in equal proportions, which gave 4·09 grains uric acid. The preference, however, assigned by Dr. Thudichum, in his able and well-known treatise on the "Pathology of the Urine," to nitric over hydrochloric acid as having given him better results led me to continue its use.

The quantity of citrate of potash taken was then raised to 350 grains for four consecutive days. On the first of these days, the uric acid found was 1·54 grains; on the second, 1·23 grains. These results were so extraordinary that, for the purpose of corroborating them, or discovering an error in the analysis, I sent 40 fluid ounces out of 61 fluid ounces voided on the latter day to Dr. Thudichum, who was so good as to furnish me with his analysis of it, containing the weights of sulphuric acid, phosphoric acid, chlorine, potash, urea, and uric acid which he had obtained. The uric acid amounted to no more than 0·775 grains.

This result led to one of two conclusions. Either independently of any question of the solution of the calculus the presence of uric acid in the bladder had been almost entirely prevented by the alkaline treatment, or the process for obtaining it was altogether unreliable. Taking the latter alternative as far the more probable, I endeavoured henceforward to improve the analysis. The mucus secreted from the bladder by the alkaline action being now a good deal in excess, I was advised that it would be prudent to diminish the quantity of alkali taken; and it was accordingly reduced, for five days, to 300 grains of the citrate, and, for eight days, to quantities varying from 270 to 240 grains. The alkalinity was now determined for every voiding with hydrochloric acid. 2·5 per cent of that acid was added to each; and, as it had been observed that uric acid was lost by decantation, however careful, the portions of urine operated upon were entirely filtered, and the water with which the precipitates were washed was acidified with acetic acid. Under this treatment, on the fifth day of taking 300 grains of citrate, the alkalinity, measured by a standard solution of hydrochloric acid, and estimated in grains of carbonate of potash, was 25·5 grains per pint. The uric acid obtained weighed 4·74 grains; and the series below 300 grains of citrate gave quantities of uric acid varying from 2·91 grains, the alkalinity being 23·05 grains per pint, to 8·42 grains, the alkalinity being 17·2 grains per pint.

One-half of that which, with 2·5 per cent hydrochloric acid, had yielded 8·42 grains was treated with 5 per cent nitric acid, and kept at the temperature of 90° F.; and, to render the experiment analogous to Dr. Thudichum's analysis, the alkalinity and dilution were brought to a similar standard by additions of carbonate of potash and water. The uric acid thus obtained weighed 2·07 grains, showing a loss, by this method, of 6·35 grains.

The following table contains an account of the uric acid obtained on the thirty-five days from October 9th to November 12th, inclusive, as well as of the potash taken, and the quantity and alkalinity of the urine:—

Citrate of Potash.	Alkali, per pint.	Uric acid.	Urine voided, in ounces.
220	16·3	6·9	51·4
20	16·8	5·6	46·6
10	22·1	8·1	40·6
255	4·2	12·2	49·7
240	19·1	7·9	47·1
240	21·3	10·6	50·7
240	30·9	9·3	55·1
225	20·0	8·4	51·9
260	36·2	6·4	46·4
270	19·5	5·5	59·0
230	18·4	6·5	56·5
240	16·8	9·1	60·7
270	22 6	7·1	53·5
270	29·0	6·6	63·5
255	27·5	8·4	59·7
285	35·4	3·23	62·5
255	40·3	7·1	52·0
240	29·4	9·6	52·0
240	19·8	8·8	52·9
225	23·3	8·7	60·3
140	10·0	11·9	64·7
140	5·0	5·1	57·2
120	1·4	4·9	44·0
120	4·2	6·4	45·0
25	5·2	7·8	51·5
185	7·6	8·4	52·5
225	26·3	7·3	51·5
210	17·4	9·7	61·9
210	22·0	7·3	64·5
210	16·4	8·3	76·4
210	19·2	8·5	42·5
210	19·5	9·4	51·4
210	19·8	9·9	63 5
195	21·3	7·6	53·5
180	21·2	11·6	55·5

In this table, the highest quantity of uric acid, 12·2 grains, is connected with an alkalinity of 4·2, while the lowest quantity, 3·2, was obtained when the alkalinity was as high as 35·4. Twenty days, in which the alkalinity of twenty-four hours varied from 19·2 to 40·3 gave an average of 7·94 grains; whilst fifteen days, when the alkalinity was from 19·1 down to 1·4, gave an average of 8·08 grains. These data would lead to the supposition that the alkali had exercised no action on the calculus; but, on the other hand, the great and sudden rise of the uric acid, when the alkalinity descended from 22·1 to 4·2, might raise a suspicion that the alkaline treatment may reduce the secretion of uric acid, and, in that case, the absence of solvent action cannot be inferred.

A good deal of blood passed with the urine from the 13th to the 16th of November, accompanied with some

diarrhœa and sickness. On the 17th, the determination of the uric acid was resumed; the alkalinity on that day being 5·3; the uric acid was 11·55 grains. On the following day, the acidity being 10·8, the uric acid was 10·38 grains.

I now instituted some new experiments, on the effect which different degrees of dilution in urine produce on the separation of uric acid. On November 19th, 40 grains of citrate of potash having been taken, the urine voided in twenty-four hours amounted to 31 fluid ounces; it was neutral; the sp. gr. was 1·032. It was divided into three equal portions, one-third in the natural condition treated in the usual manner with 2·5 per cent. Hydrochloric acid gave uric acid at the rate, for twenty-four hours, of 11·78 grains; one-third, diluted with its own bulk of water, and of sp. gr. 1·022, treated in like manner, gave uric acid 10·99 grains; one-third, evaporated down to half its bulk, and then heated with the same quantity of hydrochloric acid, gave, uric acid, 13·81 grains. November 22nd. 180 grains of citrate having been taken, the alkalinity being 1·96, and the sp. gr. 1·030, the urine for the twenty-four hours, amounting to 41·5 fluid ounces, was divided into two portions, one of which, in the natural condition, gave 12·32 grains; the other, concentrated to one-third, sp. gr. 1·070, gave 14·78 grains of uric acid. On the 23rd, the same quantity of citrate being taken, the alkalinity, 18·05, sp. gr. 1·028, the quantity of urine, 42 fluid ounces, one-half in the natural condition, gave 12·72; the other half, concentrated to one-fourth, sp. gr. 1·072, gave 14·94 grains of uric acid. On the 24th, the same quantity of citrate being taken, the alkalinity, 20·4, sp. gr. 1·030, the quantity of urine, 35 fluid ounces; one-half, in the natural condition, gave 10·318; the other half, concentrated to one-fourth, sp. gr. 1·074, gave 12·135 grains of uric acid. On the 25th, the same quantity of citrate being taken, the alkalinity, 21·2, sp. gr. 1·031, the quantity of urine, 43 fluid ounces; one-half, in the natural condition, gave 9·94 grains; the other half, concentrated to one-fourth, sp. gr. 1·075, gave 11·02 grains of uric acid. Again, on the 30th, 135 grains of citrate having been taken, the alkalinity, 37·6 the quantity of urine, 40 fluid ounces; one-half, in the natural condition, gave 8·53; the other half, concentrated to one-third its bulk, gave 12·66 grains of uric acid.

These give very nearly the two extremes of difference in forty comparative experiments, in the last fifteen of which the urine was reduced to a standard volume of 6 or 3 fluid ounces, according as half or quarter of the urine was employed; the average difference in these fifteen was 3·03, and in the former twenty-five, reduced to the proportions above described, 3.09 grains. What was the cause of the variation in the differences does not appear; it occurred equally, whether the urine was acid or considerably alkaline.

It follows, I think, from these experiments, that, to any average quantity of uric acid obtained from an unconcentrated urine, 3 grains may be added; and the last experiment described in this paper makes it probable that the employment of a better method of analysis may increase this augmentation.

I was not satisfied, however, that sufficient accuracy of analysis had yet been obtained, and I have since employed the following process, which promises more perfect results:—A fourth of the urine of twenty-four hours is evaporated to 3 fluid ounces; it is treated with a mixture of hydrochloric acid and alcohol in equal parts, each being 2·5 per cent of the quantity of urine employed; it is allowed to stand for forty-eight hours, drained on a small filter, washed with alcohol (methylated spirits), and then with equal parts of acetic acid and water. The colouring matter and phosphates, &c., are thus removed, and the uric acid is of a light colour and perfectly, though confusedly, crystalline.

The advantage which this method possesses over those heretofore in use is shown in the experiment which follows:—In urine having an acidity of 5 grains per pint, the nitric acid method of Dr. Thudichum gave 1·16 grains of impure uric acid; the ordinary hydrochloric acid method gave 5·53 grains; the method above described gave 9·90 grains of uric acid. I have found this method equally effective in the treatment of acid urine neutralized by potash, and am inclined to believe that it might be not less applicable to that which contains a greater amount of chloride of potassium.

On the whole, these experiments, though they have failed to realize my expectation of testing, by analysis, the effect of Dr. Roberts's solvent treatment on vesical calculus, may serve to point out to others the road to success in such an attempt; and if they do so, the labour of a twelvemonth will not have been spent in vain.

There is one prominent chemical fact attending these experiments which remains to be noticed—viz., the greater amount of uric acid obtained before the alkaline treatment commenced, than in the last experiment by the same process, in the proportion of 9·56 to 5·53 grains. A similar diminution has taken place in the mineral acids; whilst from 120 to 150 grains of citrate of potash were required for neutrality in August, 1868, in March and April, 1869, from 30 to 60 grains sufficed for the same purpose. Dr. Thudichum's analysis, in September, 1868, gave, of sulphuric acid, 51·1 grains, of phosphoric, 45·7 grains. The analysis made in my laboratory, in March, 1869, gave—sulphuric acid, 25·9, of phosphoric, 34·2 grains, a difference scarcely to be accounted for without reference to the alkaline treatment undergone in the first three months of the interval.

Though I have been unable to produce any *chemical* evidence in favour of the solvent treatment, a fact observed during the whole course of that treatment, and not afterwards, persuades me that a solvent action was really going on. This fact consisted in a small amount of constant deposit, in which fragmentary particles of uric acid were discerned by the microscope, enveloped in mucus, and bearing, in the opinion of Mr. Wells, as well as my assistant, a close resemblance to the detritus left by the incomplete action of carbonate of potash on fragments of uric acid calculi. I suppose these to have been washed out of the bladder in consequence of a partial solution. That no such solution should have been brought into evidence by the many determinations of uric acid, however imperfect, which I have here described, if it cannot be fully accounted for by that imperfection, may possibly be due to a physiological effect of the alkaline treatment in preventing the formation of uric acid, which may have counterbalanced the excess expected from solution of the calculus. This point, a course of experiments which need not be very long, conducted by a process of analysis reliable within a tenth part of the weight of uric acid obtained, ought hereafter to determine.

My experience of the effect of doses of 300 grains of citrate of potash taken in twenty-four hours has convinced me that no disadvantage to health need be dreaded from such a course. I have not suffered so much from dyspepsia during the last twelvemonth as in

[English Edition, Vol. XX., No 515, pages 173, 174.]

many former years. Bleeding from the bladder has, indeed, supervened twice, but without any pain or irritation, and I have had no other symptom of the complaint; and this is the experience of a man of eighty years of age, who has been for some years an invalid.

P.S. I have omitted to state that the calculus was judged to be uric from the previous passage of crystals of uric acid. Since the alkaline treatment, the urine has been perfectly clear, free from all deposits. It was never ammoniacal when voided, and contained no albumen.

ON SOME

REACTIONS OF CHLOROSULPHURIC ACID.*

BY JAMES DEWAR, F.R.S.E., AND GEORGE CRANSTON, EDINBURGH.

During the course of several experiments on the action of chlorosulphuric acid on phenol, we have noticed one or two decompositions with simple carbon compounds that may be of some interest. Since Kekulé's researches on the phenol sulpho-acids, chemists are agreed that, in these acids, the radical HSO_3 functions as a monadic group. It was but natural to expect that, if we substituted chlorosulphuric acid for sulphuric acid in forming these compounds, we should arrive at similar bodies, with this difference, that, in the one case, we should eliminate the hydrogen of the group acted on as water, and, in the other, as hydrochloric acid. Now, a critical examination of recent researches in the aromatic derivatives shows that certain groups or elements used as substituting agents tend to approach or separate, thereby producing isomeric compounds: for instance, Korner's celebrated synthesis of resorcine starts from dinitrobenzine, where the relative position of the two NO_2's is maintained throughout the number of complex compounds through which this chemist passed in order to replace the NO_2's by hydroxyls. But, if we examine the intermediate compounds produced, it is evident that, if we could change the conditions or modify the relations of the substituting groups, we might arrive at the same products by direct substitution. Thus the dinitrobenzine produced in the second stage of the before-mentioned synthesis might be made directly if we could form nitro compounds by some reagent other than nitric acid. The experience we possess at the present time is too meagre to admit of any attempted prediction of what would be the effect of substituting the same radical from different sources.

It was our intention to have investigated one reaction from this point of view, and we chose, for this purpose, an examination of the sulpho acid, or acids that would be produced by the action of chlorosulphuric acid on phenol, as compared with the sulpho acids produced when sulphuric acid is used. We were engaged in this direction when Engelhardt published his interesting paper bearing on this point. We have, however, noticed one or two reactions of this substance that may be acceptable at the present time.

The chlorosulphuric acid used in this investigation was prepared by the direct action of sulphuric acid on hydrochloric acid. We found the reaction to go with great ease and rapidity, the temperature of the sulphuric acid, containing a large percentage of sulphuric anhydride, rising to 120° C. The substance had all the properties ascribed to it by Williamson. In our first experiments, we attempted to prepare the acid by acting on sulphuric acid with pentachloride of phosphorus, as described by Williamson. We found it impossible to free the chlorosulphuric acid completely from oxychloride of phosphorus.

We attempted the formation of Kolbe's trichlormethylsulphurous acid by the action of chlorosulphuric acid on chloroform, expecting $CHCl_3 + Cl(HSO_3) = CCl_3(HSO_3)$. We found that, when equivalent quantities of chlorosulphuric acid and chloroform were heated in a sealed tube to 120° C., instead of obtaining Kolbe's acid, we got the decomposition products of this acid—sulphurous acid, hydrochloric acid, and chlorocarbonic acid, thus—$CCl_3(HSO_3) = CCl_2O + HCl + SO_2$. The pressure in the tubes being so enormous, we found them extremely liable to burst. No doubt tetrachloride of carbon would give a similar decomposition, with the difference that SO_2Cl_2 would be produced simultaneously. This reaction is interesting, as Schutzenberger has just shown the formation of phosgene gas by the action of sulphuric anhydride on tetrachloride of carbon.

We have examined, also, the action of chlorosulphuric acid on bisulphide of carbon. When equivalent quantities of chlorosulphuric acid and bisulphide of carbon were heated in a sealed tube to 100° C. for some hours, we found the non-miscible liquids changed into a clear, mobile liquid, from which had deposited large yellow crystals of sulphur. The tubes, when carefully opened, continued to evolve gas until the whole of the mobile liquid disappeared: the liquid was condensed sulphurous acid. The gas was collected over water, when a large quantity was rapidly absorbed. The gas not absorbed after it had stood for some time over water we have carefully examined, and found to have all the properties of oxysulphide of carbon. This reaction is interesting as showing the formation of oxysulphide of carbon by direct substitution of sulphur in bisulphide of carbon by oxygen. The reaction is evidently—

$$CSS + Cl(HSO_3) = CSO + HCl + SO_2.$$

Probably the reaction would succeed better by the action of sulphuric anhydride on bisulphide of carbon. In this case, the pressure in the tubes would be greatly diminished by evading the presence of the hydrochloric acid gas. Lautenberg has recently shown the formation of oxysulphide of carbon in many reactions; and this is another instance in which it is produced.

* Read before the British Association, Exeter meeting, Section B.

THE PREPARATION OF SESQUICHLORIDE OF CARBON.

BY H. BASSETT, ESQ.

The vapour of tetrachloride of carbon is passed moderately slowly through a glass tube about 30 inches long, kept at a moderate red heat. The end of the tube fits into a quilled receiver, provided with a tube to carry off the excess of chlorine. The liquid condensed is dark yellow, from the chlorine held in the solution, and consists of sesquichloride of carbon, C_2Cl_6, and the liquid chloride, C_2Cl_4, with unaltered tetrachloride. It also contains a very small quantity of the chloride C_6Cl_6.

On exposing this liquid to a good light, the excess of chlorine is absorbed by the C_2Cl_4. It is then distilled with a thermometer. When the temperature has risen to 150°—160°, the residue in the retort consists almost entirely of C_2Cl_6, retaining the trace of C_6Cl_6 and a little impurity, which gives it rather a dark colour. It is poured out into a dish, when it soon becomes solid, and

may be purified by crystallisation, or by distillation with the vapour of water. The distillate under 160° is then saturated with chlorine in a good light, when the whole of the C_2Cl_4 is converted into perfectly white C_2Cl_6, which is easily separated from the unaltered CCl_4 by distillation.

In this manner there would be no difficulty in preparing the sesquichloride in any quantity.

ON A VERY

CONVENIENT METHOD OF ASCERTAINING THE CONSTITUTION OF FLAMES.

BY M. L. DUFOUR.

M. Dufour recommends the following process for demonstrating, for instance, that the flame of a candle is formed of a hollow cone, luminous on the outside only, and dark in the interior. For this purpose it is necessary to cut the flame; the most preferable method of doing this is by means of a sheet of water or air. The arrangement is as follows:—A caoutchouc tube has, at one of its extremities, a gas jet, such as is used for common gas flames; this jet has an almost semicircular slit of 0·4 m.m. in depth. The other end of the tube communicates with a reservoir of water placed at a convenient height. Upon a suitable pressure, the water flows out by the slit in the jet, producing a clear sheet capable of preserving, for a sufficient length of time, an invariable form and size. The slit is placed in such a manner that the sheet presents a horizontal surface; and this will easily cut the flame of a candle, showing a perfect section. The hot gases and carbonaceous particles are carried off by the water. On placing the eye above the hollow cone, the luminous wall, &c., can be distinctly seen. Sections may easily be made near the wick or near the point; nothing hinders observation, which may be prolonged at pleasure, and a lens may be used if desired. A flame of gas may be cut and examined in the same manner, but the current of gas must not be strong enough to traverse the sheet of water. If a current of air be caused to come out of the slit by bellows, an invisible sheet of air is formed which is, also, very convenient for making a section of flame. Close observation is quite possible; for the aërial current prevents the heated gases from reaching the eyes, and a lens may be used, as in the former case. The flame forms a cone, whose luminous walls are extremely thin, and their interior can be plainly seen. A platinum wire may be introduced across the section; and, on being plunged as far as the wick, it will remain unreddened in the dark interior of the cone.

A jet of gas issuing from a circular opening, of from 1 to 2 m.m. in diameter, may also be cut very conveniently by the sheet of air. It will be seen to consist of a cone whose walls are brilliant and extremely thin. Upon bringing the sheet of air close to the aperture whence the gas escapes, the flame will be divided at its base and will reappear a little higher. By this means, the entire length of the luminous cone, its thin walls, and their interior may be examined.

If a jet of gas produced by a fan-tail burner be cut, the luminous fan will be found to consist of two brilliant blades, between which there is a narrow obscure space. The blades are at a great distance apart, and the dark space is wider towards the end of the fan-tails; and, by assuming a suitable position, it is easy to see through the section of flame into the dark space which separates the brilliant walls, and at the end of this will be seen the slit by which the gas escapes.

Instead of throwing the sheet of air perpendicularly to the flame, M. Dufour thinks it better to throw it partly on one side, on such a plane as to make a slight angle with the axis of the conical flame, or with the plane of the fan-shaped flame. A lateral suction is then produced by the influence of the current, which draws the flame, and inclines it against the sheet of air, by which it is cut. By placing the sheet of air on a more or less inclined plane, and approaching or removing it from the base of the flame, the section is easily made at points more or less distant from that base.

The method described above may, of course, be applied to any kind of flame. M. Dufour suggests that it might be of service in the chemical analysis of flames. When a flame is cut by a sheet of water, the water draws off the gases of which it is composed. If the section be made with a sheet of air, it will be easy, by placing suction pipes throughout the length, and ending at fixed points in the interior of the cone, to collect the gases whose composition is desired to be ascertained.—*Les Mondes.*

THE ECONOMICAL PURIFICATION OF ZINC CONTAINING IRON.

BY W. H. CHANDLER.

In the galvanising of iron, the article to be galvanised, after being thoroughly cleansed, is dipped into a kettle of molten zinc, which forms an alloy with the iron at the surface of contact, and by repeating the dipping the thickness of the superimposed zinc may be increased at pleasure. In the prosecution of this manufacture, the zinc is held in large iron troughs or kettles, which are rapidly corroded in those portions nearest the fire. An alloy of zinc and iron is formed, to which also the articles, being galvanised, in some degree contribute. This alloy being heavier than the purer zinc, sinks to the bottom, and, from time to time, is removed by perforated ladles.

The composition of the alloy is of course somewhat variable, depending upon the temperature and fluidity of the zinc and the careful straining from the fluid metal. The two analyses here given were made by the writer a number of years since:—

Zinc	94·27	94·15
Iron	5·46	5·00
Lead	0·27	0·56
Tin	trace	0·29
	100·00	100·00

These samples were taken from a re-melting of a large quantity of the alloy, which is the only practicable method of obtaining a fair average specimen.

The quantity of this dross or refuse is quite considerable, amounting probably, in the United States, to several hundred tons per annum. Formerly it was sold for use in coarse brass castings, and to some extent it was re-distilled. At one establishment in Boston circular clay retorts, similar to those in use in the gas manufacture, were employed, the molten alloy being introduced through an inverted syphon in the iron

mouthpiece and the condensing tube, connected with the reverse end of the retort, dipping in a pot of molten zinc; thus all access of air to the interior of the retort was prevented, and little or no oxidation of the zinc occurred.

Several years since, a small lot of this refuse zinc was received at a metallurgical establishment in Massachusetts, in which the writer was employed as chemist, and, in experimenting upon it, one of the foremen of the establishment originated a method by which the zinc could be obtained quite free from iron. Finally, after re-building his furnaces and in various ways altering and modifying his manipulations, the samples of purified zinc being analysed after each alteration of the process, a good commercial article was obtained containing only one-tenth of one per cent of iron.

The process consists in melting the refuse in an iron kettle, raising the heat nearly to the point of volatilisation of the zinc, and then, by a proper regulation of the heat, cooling the mass slowly from the bottom, by means of a special arrangement of flues. An alloy of zinc and iron, containing a much larger percentage of iron than the original refuse, gradually forms, falls to the bottom of the kettle, and is removed by a perforated ladle, while the fluid metal is much purer. The quantity of alloy to be ladled out depends upon the impurity of the original refuse. The purified zinc and the concentrated impurity are melted in separate kettles, and each treated as in the first operation.

One more fusion and refrigeration of the purified zinc and the still more impure zinc, render the former a good commercial spelter and the latter too impure for further economic treatment.

This process is the reverse in its reactions from Pattison's process for desilverising silver-lead ores. In the latter case the purer lead crystallises from the more fluid lead and silver, whereas in the former, the more impure alloy separates from the purified zinc.

The residue from this process, which is sold for distillation, consists of hexagonal prismatic crystals of a fixed alloy of iron and zinc, loosely agglomerated together so as to crumble in the hand.

When the operation of refining is badly conducted, more or less zinc acts as a solder for the crystals. They are beautifully iridescent, exhibiting all the colours of the rainbow, owing to a surface oxidation. A number of specimens of various colours were selected for analysis and showed a composition of—

Zinc	90·50
Iron	9·50
	100·00

Upon fusing these crystals, which requires a high temperature, and cooling as before, a small percentage of purified zinc is obtained, and an alloy containing as much as 12½ per cent of iron. This is compact, somewhat brittle, and exhibits no evidences of crystallisation.

This last-mentioned fusion is not made in practice, as the great heat required for its accomplishment rapidly burns out the iron kettles.

By a similar process lead has been removed from zinc with great accuracy, the amount obtained closely approaching the quantity therein. From a lot of Silesian spelter was separated lead perfectly malleable, and containing scarcely a trace of zinc. The purification of the lead, obtained from the process of desilverisation of silver-lead by means of zinc, could undoubtedly be accomplished by a modification of this process.

A NEW AND ECONOMICAL METHOD

FOR EFFECTING THE

EXTRICATION AND CONDENSATION OF AMMONIA FROM GAS LIQUOR

FOR PURPOSES OF CHEAP CARRIAGE, AND FOR FACILITATING THE MANUFACTURE OF AMMONIACAL SALTS.*

BY FREDERICK BRABY, F.G.S.

It is but a very few years since that the various bye-products obtained from the manufacture of coal gas were not merely a drug in the market, but proved an absolute nuisance to the manufacturer and to the general public.

Coal tar was even burnt under the retorts, or was introduced therein for the production of gas; and gas liquor was commonly given away to any one whose ingenuity might enable him to turn it to a useful purpose.

But the progress of science in this, as in other cases, soon discovered applications where none were supposed to exist.

From coal tar are not only now obtained naphtha, benzol, carbolic acid, and other valuable derivatives, but also the brilliant and diversified colours of what are called aniline dyes are obtained from the same source. The ammoniacal liquor, too, to which, on the present occasion, I desire to be favoured with your attention, is now not only not given away in the Metropolitan and other districts, but, in certain localities, the greatest competition exists for its acquisition. It at present constitutes, in this country, the principal source of ammonia, and, consequently, of the ammoniacal salts, which are so usefully and so successfully applied in the arts, and more especially to agriculture. In London and its neighbourhood, the purchase of the residuary products of the various gas companies is eagerly sought after, and it is now considered a privilege to be allowed permission to tender for them for the term of one, two, or more years' supply. Practically, the tar and gas liquor trade is in the hands of a few parties jealously desiring to exclude outsiders, who thus find it extremely difficult and often absolutely impossible to obtain even a few thousand gallons.

The object of the present communication is to show how the demand for gas liquor which so far exceeds the means of actual supply can be met. It is to show, moreover, that by condensation and reduction of bulk for transport, small and remote gas works may be enabled to utilise and export their residual products at a profit; and above all, how, by the introduction of certain improvements, the quantity of ammonia, as produced and utilised from the manufacture of gas, may be practically increased from ten to fifty fold.

The strength of gas liquor is commonly specified in the various tenders as technically 6 oz. The prefix, denoting the number of ounces, refers to each gallon of the liquor, and does not signify the number of ounces of ammonia that are present, but the number of ounces of sulphuric acid which would be required to neutralise the ammonia. Consequently a butt of 108 gallons of 6-oz. liquor implies, by calculation, that 108 times 6 ozs. or 40 lbs. of sulphuric acid are required to saturate the whole quantity. Now it is found in practice that, if we divide the quantity of sulphuric acid required by 3, we shall get at the quantity of ammonia

* Read before the British Association, Exeter meeting, Section B.

actually present. This result closely agrees with theory, the equivalent of dry ammonia being 17, and that of monohydrated sulphuric acid (oil of vitriol) being 49; the proportion is very nearly 1 to 3. It follows, therefore, that, as 40 lbs. of sulphuric acid are required to saturate a butt of 6-oz. liquor, so one-third of this or little more than 13 lbs. of real ammonia are contained in this immense quantity of liquid and merchantable product, weighing as it does in the aggregate no less than 1107 lbs., or half a ton. On referring to the ordinary commercial standard, viz., of 6 ozs. to the gallon, 6 ozs. of sulphuric acid divided by 3 gives 2 ozs. of ammonia as the entire quantity present. Now a gallon of the gas liquor weighs 10 lbs. and, if the lbs. be multiplied by 16 to reduce them to ounces, we have a total of 160 ozs., containing only 2 ozs. of real ammonia or 1 oz. to 80 ozs. of water.

The result of this is, practically, to prohibit the transport of gas liquor over any but moderate distances, because, in its present form, for every ton of real ammonia carried by barge, tank-cart, or otherwise, no less than 80 tons of water must be carried for no other purpose but as a solvent. It must not be inferred, however, that the *whole* of these 80 tons of water is waste carriage. Ammonia in a free state cannot be conveniently carried, except when dissolved in a certain quantity of water. It would not be judicious to concentrate the ammonia to a higher degree than 0·900, since if, in course of carriage, it were subjected to any great degree of heat, the water at an elevated temperature would disengage some of the NH_3 held in solution, and such a disengagement of ammonia might be attended with dangerous results. A very useful and safe solution for all purposes of transit would be about one part by weight of ammonia to four parts of water; this would reduce the present cost of carriage for this important article to no less than twenty times, or, in other words, the transit of a certain quantity of ammonia over a certain distance costing now £20 would, if conveyed in the above concentrated form, be reduced to 20s. This scale of reduction would at once enable it to be carried by rail in petroleum or other barrels, or in tank-trucks, or otherwise, and would bring the numerous gas works which are scattered over the United Kingdom within economical transport of the centres of manufacturing industry, so that this important bye-product of gas-making might be utilised for the general good, and be not so extensively wasted as has been, and is now, frequently the case.

In order to effect this desirable object, I recently, in conjunction with Mr. Baggs, secured a patent for effecting the necessary concentration of ammonia by certain novel means, which promise in practice to prove far more rapid and economical than any hitherto employed. The process may be shortly described as follows:—To the common ammoniacal gas liquor a certain quantity of slaked lime is added. The liquor thus treated is placed in a capacious boiler or still containing from four to five thousand gallons. The whole is then heated and maintained at a temperature of from 100° to 200° F., the liquor being slowly but constantly stirred by means of an internal agitator, the spindle of which passes through a stuffing box in the end of the boiler. A powerful blast of air from a double-action force-pump, actuated by a small steam-engine or otherwise, is blown continuously through the liquor. The air enters by two long perforated pipes placed near the bottom of the boiler, and in its upward passage it is compelled to pass through a horizontal diaphragm drilled with numerous small holes. The result of this arrangement being that the air, in its ascent, is subdivided into innumerable small sheaves and bubbles, to each and all of which, in accordance with well-known and recognised laws, the ammonia attaches itself and is carried away with only a very small proportion of aqueous vapour. An exit pipe is fixed to the top of the boiler, so as to carry away the mixture of air and ammonia, and the extremity of this pipe dips into a supply of water contained in a cold and suitable receiver, where the ammonia is immediately absorbed, and the air, after thus effecting its removal in a separate state, escapes through the water and is permitted to pass off into the atmosphere. The condensers are generally arranged like a series of what are known as Woulfe's bottles, but for the purpose of obtaining great strength and purity, this arrangement may be superseded in the manner following.

The ammoniacal gas separated by the air is purified in a manner which will be afterwards described, and is then caused to pass into a vessel about three parts filled with broken lumps of pure block ice. From the well-known affinity of ammoniacal gas for cold water, the gas is arrested by the ice, which is rapidly liquefied, and a pure solution of ammonia of any required strength is obtained. It is advantageous to cool down the mixture of air and ammoniacal gas before it is allowed to enter the condenser; the air, after having parted with the ammonia which has been dissolved by the liquefied ice, passes off into the atmosphere as in the former instance. The finest Norwegian transparent block-ice may, in the height of summer, be obtained at the London Docks at 23s. per ton, and even less, according to the number of tons required, the supply being constantly maintained by the arrival of fresh ships. Or ice may be obtained by one of Siebe's refrigerating machines almost as cheaply as that which is imported.

This patent process for separating the ammonia by blowing air through gas liquor, when at an elevated temperature, is so much more rapid in the operation than the process of merely boiling the gas liquor as hitherto conducted that, with a very moderate-sized apparatus, several thousand gallons of gas liquor can be treated in a single day, and the ammoniacal produce of the largest works may be continuously converted into a concentrated and more portable form without trouble or delay. Even in the smallest works, consuming not more than from ten to fifty tons of coal a week, the bulk and weight of the gas liquor may be quickly reduced, and the result will be of such standard value that a still containing from 20 to 100 gallons would, probably, in such cases, answer every desired purpose, and would be found to be remunerative. In many instances the gas liquor might be heated and the power supplied, if desirable, from the waste heat of the retorts.

By the adoption of this improved process the present trade in crude ammonia may be expected to expand and to become of higher importance than it now is.

The comparatively limited supply which is now available restricts its application. The commercial advantages which would be derived from the many technical purposes to which it is applicable would be considerable, and manufacturers being enabled to obtain cheap supplies from distant sources, the total quantity utilised would be immensely increased.

When, instead of producing caustic ammonia it is

desired to manufacture ammoniacal salts, the ammoniacal gas in conjunction with the atmospheric air may be conducted into sulphuric or muriatic acid, or into a metallic or saline solution capable of appropriating the ammonia.

As the evaporative power of air increases with the absence of moisture therein, it is possible that, by drying the same artificially before introducing it into the liquor, it would take up a great quantity of ammonia. The removal of all moisture from air may be effected with comparatively little expense by the suction of the air required for the forcepump through sulphuric acid, and a close wooden box containing lumps of chalk. This method is well known in connection with other applications.

The blast of air may be hot or cold, and may be delivered in any manner adapted to increase and effect more intimate contact between the air and the liquid containing the ammonia.

By adopting what I call the atmospheric or blowing principle, nearly the whole of the ammonia can be liberated from the solution in which it is contained, without any fire or external heat applied to or under the still or boiler, but, if the liquor be heated, the solubility of the alkaline gas is diminished and its extraction is facilitated.

Gas liquor is, in this country, the most common, and at the same time the most economical, source of ammonia, and the system of extraction by forcing air would, of course, be equally applicable to ammoniacal bone liquor, or to any other chemical preparation in which the caustic ammonia is held in solution.

The principles already indicated may, perhaps, be illustrated with advantage by a brief description of a working-plant actually constructed at Deptford for the purpose of extracting ammonia. An excavation has been made, in which is sunk a reservoir for containing the gas liquor, and having the following dimensions:—namely, 35 feet long, 7 feet wide, and 6 feet deep. The bottom is formed of 1 foot of concrete, two courses of bricks, and of two courses of red flat tiles; the sides are of 14-inch brick-work, two courses with tiles in conjunction with concrete.

The wrought-iron still is set in brick-work, so that flame may play more than half round its external surface. It is 30 feet long by 6 feet in diameter. About 4000 gallons of gas liquor are pumped into it from the reservoir for the purpose of being operated upon.

Heat is applied by means of a fire underneath, but a coil of hot air or steam pipes placed in the interior of the still or boiler would be equally efficacious. Two cast-iron 3-inch air-pipes, which are attached to the ammonia generator, extend along its whole length, and are situated one on either side, and nearly at the bottom. They are perforated with holes increasing in size as they extend from the inlet. Into these pipes, and from them into the gas liquor, is driven atmospheric air by means of a pair of cast-iron force-pumps. These are 20 inches in diameter, 1 foot 8 inches stroke, with rods and slings, wrought-iron connecting rod and crank, and a cast-iron beam 6 feet long. On the entry of the streams of air they are caught and agitated by the twelve iron fans of a stirrer, making about 80 revolutions per minute.

The air, together with the lime and the various constituents of the gas liquor (viz., water, ammonia, carbonic dioxide, sulphuretted hydrogen, sulpho-cyanides, &c.) are thus brought continuously into intimate contact. The air loaded with the volatile alkali which has become eliminated from the solution passes upwards into the steam chest and through a branch pipe into the purifier or washer. This is a small wooden vessel of the capacity of 350 gallons, containing lime and being about one-third full of water. It has a tight head and a stout perforated elm false bottom, the holes being concentric and increasing in number and dimension as they radiate from the inlet, which is brought below the false bottom.

This purifying vessel is furnished with a small agitator having two blades, one revolving above and the other below the false bottom. There are two trial or test taps at appropriate heights, to test for gas or for water, and there is also a pipe sealed at one end, rather less than half way from the bottom, for the purpose of leading away any excess of liquid that may accumulate owing to the condensation of aqueous vapour which may pass over with the volatile alkali. There is a long straight tube or safety pipe from the washer, and the bent pipe from the ammonia generator is also provided with a safety valve and a vacuum valve. In the washer the ammonia is deprived of any remaining hydrosulphuric acid or other impurity that may have escaped being fixed in the generator. About half a bushel of finely sifted slaked chalk lime is found to be a suitable charge for the washer, and when this becomes saturated or impure, it is renewed by means of a pipe and tap placed at the bottom of the vessel. The washer being a close vessel soon becomes full of air and gas, which are forced by the pressure through a pipe opening into the top and leading to a coil or worm placed in a cold water cistern, and terminating in a deep close vessel about one-third full of pure cold water, which has been condensed from the waste steam from the engine. A portion of the ammonia becomes absorbed by the water, but the residue, together with all the air, after bubbling up through the liquid, is conducted by a bent pipe to nearly the bottom of a second similar receiver, and thence in the same way to a third, but which is opened at the top.

The air, having fulfilled its function, is now permitted to escape into the atmosphere, the whole of the ammonia having, however, been arrested.

This last receiver, instead of water contains a strong solution of chloride of iron, which being denser and possessing a higher specific gravity than water, offers a greater pressure and resistance to the passage of the gas. The iron salt is, of course, decomposed, with formation of muriate of ammonia in solution, with deposition of a green mud containing sesquioxide of iron, which, after having been calcined, is found to constitute an excellent pigment for rough iron or wood-work.

After the whole of the ammonia has been extracted from the gas liquor, the contents of the still are run off into a draining pit, from which the clear solution finds its way into the sewers, and the solid inodorous lime compounds may be carted away.

This draining pit is constructed of 1½ inch deal boards together with sand and brick-work. It is 4 feet 9 inches wide, 5 feet 4 inches deep, and 10 feet long. There are fillets whereon to rest three perforated shelves or platforms. The bottom is formed of perforated deals with six inches of sand, also with gravel, and cement. There are channels and small drain-pipes leading into a large central earthenware pipe, and from thence into the sewer. The sharp sand, &c., under the perforated boards can be removed at will, and be replaced by fresh materials whenever required.

Care must be taken that the large pipe from the boiler

to the washer be sufficiently high to guard against any back pressure. The vacuum valve opens and admits air when the fire of the still is withdrawn and the steam becomes condensed.

In order to ascertain the exact state of the contents of the boiler at any required height, and to avoid tapping the upper portion of the boiler at too many places, the following simple contrivance is adopted:—There is one tap at the lower end, to which is attached a short pipe inside the still working easily on an elbow. To this pipe is connected a copper wire having its outlet just above the external surface of the boiler, and by which wire the short pipe may have its orifice presented at any required height, at which it is desired to ascertain the state of the contents of the vessel. For instance, supposing the fire to be withdrawn, and the agitators to be quiescent, if the end of the tube were pulled up by the wire and the tap opened, a clear liquid would issue, which could be tested in order to ascertain whether the whole of the ammoniacal gas had been removed. On the other hand, if the short tube were allowed to lie along the bottom of the still, the opened cock would allow the green sulphocalcareous mud to escape. It is stated in Dr. Miller's "Elements of Chemistry" that, at a temperature of 32°, water takes up about 1050 times its volume of ammonia; at 59°, 727 times, and at 78°, 586 times its volume. Water saturated with ammonia at 60° contains more than one-third of its weight of the gas, increasing in bulk from 1·0 to 1·5, and becoming specifically lighter.

Hence the receiver should be not more than one-third or one-half full of water to allow for the increase in bulk caused by the solution of the ammonia.

In July, 1867, valuable papers upon the utilisation of the waste products of the manufacture of coal gas were read before that important body, the British Association of Gas Managers, by two of our first authorities on this subject, Dr. Letheby and W. Esson, Esq. Dr. Letheby declares that it is so manifestly of the greatest importance that the liquor should be sent away to the gas works as strong as possible; it ought, in fact, never to be under 6° Twaddle, or of less than 12 ounces strength, and with proper condensation and judicious washing there should be from 29 to 30 gallons of such liquor produced from every ton of coals. The price in London is 2s. per butt, 8-oz., with an increase of 4d. per oz. on every additional ounce of acid strength. Below 3° of Twaddle or 5 ounces of acid it does not pay for working, whereas at 10° or 11° of Twaddle it is a valuable product. Both Dr. Letheby and Mr. Esson emphatically insist upon the importance of the strength of the ammoniacal liquor. So rapidly does the commercial value augment, in relation to its concentration that, whereas a butt of 108 gallons of gas liquor is worth 4s., the same quantity of caustic ammonia of specific gravity 0·900 is worth from £15 to £20. A lower strength of gas liquor than 6-ounce has not hitherto been thought worth working, but one advantage in Braby's system of extraction and concentration consists in the fact that a high strength is not indispensable. Even 2 ounces would in practice yield a profit.

As an evidence of the importance of an increased supply of ammonia and of its large demand, it may be mentioned that a firm with which the writer is connected recently offered 4s. per butt of 6-ounce liquor, and yet was unable to obtain a supply, showing that the value has doubled in the short space of two years. Mr. Esson describes an economical arrangement for the extraction of ammonia from gas liquor with the assistance of steam, and by an apparatus similar to a Coffey's still, but which is subject to the disadvantage that the noxious gas (sulphuretted hydrogen) is not simultaneously fixed or disposed of, and that at least 15 per cent of ammonia is left in the liquor, which has afterwards to undergo the supplementary process of distillation with lime. The present ordinary method of making liquor ammonia is, as far as I am acquainted, from sulphate of muriate of ammonia, which is itself obtained from gas water. By Braby's process, liquor ammonia may be obtained much more quickly and economically from gas-liquor direct.

There are many gas-works where ammoniacal salts are now manufactured; but it is suggested that, in new works, or at those where the gas-liquor is not at present utilised, it would be preferable, in the event of the adoption of the principle herein advocated, that the ammonia, after concentration, should be sent to the sulphuric or muriatic acid works, rather than that the acids should be sent to the gas-works. In metallurgy, it is found more advantageous to transport the calcined or partly-prepared ores to the coal districts for smelting, rather than to take the fuel to the mines.

Barges fitted with tanks ordinarily employed in the conveyance of gas-liquor contain from 3000 to 8000 gallons. A land journey of 12 miles with two horses for a load of 500 gallons in a tank-van now costs £1. By rail, the cost of freight is 1d. per ton per mile.

The advantages of the above-described system may be summed up as effecting a considerable economy in labour, time, and occupation of plant, together with the facility of extracting the whole of the ammonia from the gas-liquor in a pure condition. A manufactory previously consuming 10,000 gallons of gas liquor per week, may now utilise 24,000 gallons, and at about half the expense of fuel of that formerly incurred.

The great interest of this subject in a chemical point of view, its high importance to the metallurgist and manufacturer, and the increasing value of ammonia to the farmer (with whom it is almost another name for fertility and abundance), must constitute my apology for having engaged so much valuable time in its consideration.

NOTE ON THE EARLIER HISTORY OF THE SCIENCE OF HEAT.

BY GEORGE FARRER RODWELL, F.C.S.

As a supplement to the lectures on "Heat" which have recently appeared in this journal, it will not, I think, be out of place to give a short account of some of the principal facts connected with the earlier history of the science of Heat. In doing this it will be impossible to preserve any great continuity, my object being rather to indicate some of the old scientific treatises in which experiments are detailed, and to supply the student with a means of reference which the foregoing lectures of necessity could not afford. The memoirs and the works of recent writers on Heat are so well known and so much at the command of all who desire to pursue the study, that it will be sufficient to mention the names only of Cazin, Clausius, Despretz, Franz, Guthrie, Helmholtz, Herschell, Hirn, Joule, Knoblauch, Kopp, Magnus, Mayer, Melloni, Pouillet, Regnault, Balfour Stewart, Tait, Thomson, Tyndall, and Wiedemann.

It is difficult to say when the science of Heat, properly so-called, first arose. It is certainly a younger science than Statics, Dynamics, Hydrostatics, Hydro-

dynamics, Pneumatics, Optics, Static Electricity, and Magnetism. I question whether Acoustics can be added to this list, although it has ever had the stimulating effect of the art of music, which, in its turn, had the stimulating effect of Church Ceremonial, and attained some perfection in the 16th century, and much perfection in the 18th. M. Libri very truly says, "Les recherches des Pythagoriciens sur les vibrations des corps sont les plus anciennes expériences de physique qui soient parvenues jusqu'à nous,"* but we must bear in mind that the results of these experiments were applied to music as an art, rather than to sound as a science. Omitting, then, the question of the precedence of Acoustics, we yet perceive that Heat is among the younger of the sciences. This arises from the fact that, until late in the last century, heat was regarded as a chemical agent, and became merged more or less into chemistry proper. Separate treatises on Heat were unknown, but every chemical work devoted some chapters to the acts and operations of fire, "Car en effet," as Lemery remarks, "c'est par le moyen du feu qu'on vient à bout de presque toutes les opérations chimiques." Hence arose such expressions as "Chymick heat," "ye hete of ye chimists fornace," &c., to designate intense degrees of heat. Then, again, the theory of Phlogiston is essentially a heat theory in one sense, but it has ever been regarded as a chemical theory, because the action of heat is so closely associated with the majority of chemical operations that the scientific cared not to step aside to examine the nature of heat itself, preferring to leave the examination of the cause to study that of the ultimate effect. Boerhaave in his admirable *Elementa Chemiæ*, the most extensive chemical work which had up to that time (1732) appeared, devotes a good deal of space to the "instruments" of chemistry, "beginning," as he remarks, "with fire, by reason that no chemical operation ever was, or can be hereafter performed, to which fire does not contribute." (It may be remarked here that *fire* and *heat* were often used as almost synonymous terms by old writers; thus Boerhaave says "Fire expands even the hardest bodies.") I imagine that Francis Bacon's little treatise, *De Formâ Calidi*, was the first attempt to raise Heat into a separate science. It was an utter failure, yet the attempt is to be applauded, for it was the lack of observation and the paucity and obscurity of the knowledge possessed at that time by the world at large in regard to heat, that of necessity resulted in the failure. What are we to say to such an assertion as the following? "Omnino calor cælestium augetur tribus modis; videlicet ex perpendiculo, ex propinquitate sive perigæo, et ex conjunctione sive consortio stellarum." S. Gravesande in his excellent *Physices Elementa Mathematica*—one of the best illustrated works on Physics which has ever appeared, and which may even now be consulted with advantage,—gives 45 pages ("Editio tertia, duplo auctior," 1742) to heat, and 234 to light. He commences the "Liber de igne" with the very pertinent remark, in his blunt rugged Latinity, "Pauca de igne norunt philosophi; multa ipsos latent," adding very sensibly (and it is to be wished that his example were more often followed) "Hypotheses non fingam; generaliora, quæ experimentis deduci posse mihi videntur, eo quo potero meliore ordine, dicam."

The production of fire by the refraction and reflection of the rays of the sun was well known to the ancients. The sacred fire of Vesta was re-kindled by the rays of the sun reflected from a metallic mirror, and, according to Pliny, the mirror was sometimes replaced by a glass globe filled with water. Aristophanes clearly alludes to the use of glass lenses as burning glasses in the Νεφελαι.

Lactantius, in his curious treatise, *De ira Dei*, mentions that a glass globe filled with water and placed in the rays of the sun, will kindle fire even in the coldest weather.* Baptista Porta in his ever new, ever interesting treatise, *Magiæ Naturalis*—which links the magic of Art of Eastern civilisation with the magic of Nature of Western civilisation, Chaldæan mysticism and Theurgy with the Realism of the Renaissance,—Baptista Porta mentions the fact that heat, sound, and cold may be reflected by mirrors in the same manner that light is reflected. As a delicate instrument of observation in the case of the reflected cold, Porta placed his eye in the focus of the mirror, as, some two and a half centuries later, Dr. Tyndall placed his eye in a focus of dark heat rays in order to see whether any light accompanied the heat rays. Porta's account is interesting; it occurs in the seventeenth book, and is entitled "Calorem, frigus, et vocem speculo concavo reflectere." "Si quis candela in loco," he continues, "ubi spectabilis res locari debet apposuerit, accedet candela per aerem usque ad oculos, et illos calore et lumine offendet, hoc autem mirabilius erit, ut calor, ita frigus reflectitur, si eo loco nix objiciatur, si oculum tetigerit, quia sensibilis etiam frigus percipiet." Somewhat later Hamerus Poppius calcined antimony "per radios solares" with the use of a lens, in order to determine whence came the gain of weight. Bonaventure Cavalieri, the discoverer of infinitesimals, writing in 1632, states that he was able to inflame dry substances by reflecting the heat emitted by a charcoal fire by means of a spherical speculum; by using a parabolic reflector he produced the same effect at a distance of 5 feet, a small fire of wood being the source of heat. He recommends a hyperbolic reflector, and asserts that the impressions of heat, cold, sound, and scent move in straight lines.† Athanasius Kircher has also treated of reflection in his *Ars Magna Lucis et Umbræ*.

The term "radiant heat" was introduced by Scheele in his treatise entitled *Luft und Feuer*. Pictet in his celebrated *Essais Physiques sur le Feu* (1790) demonstrated the enormous velocity of propagation of radiant heat; he also treats of absorption and reflection of heat, and of latent and specific heat. Prevost made known his "Theory of Exchanges" in 1791 through the medium of the *Journal de Physique*.

Black discovered "latent heat" about the year 1760; his pupil Irvine introduced the term "capacity for heat," while Gadolin replaced it in 1784 by the term "specific heat." In connection with the determination of the specific heats of various substances, the following names are most prominent:—Wilke, Lavoisier, Laplace, Kirwan, Dalton, Dulong, Petit, De la Rive, Regnault, Favre, Silbermann, Bérard, De la Prevostaye, and Desains.

* "Histoire des Sciences Mathématiques en Italie." 1838.

* Lactantius was born about A.D. 250; he died in 326. His works were amongst the first printed in Italy; the first edition issued from the press of the monastery of Subiaco as early as the year 1465, while a second issue appeared in Rome in 1468, in both cases it will be remembered before a single book had been printed in this Island. The passage alluded to above is taken from the tenth chapter, entitled "De mundi ortu, et rerum naturæ, et Dei providentia," and is as follows—"Omitto silicem, ac ferrum. Orbem vitreum plenum aquæ si tenueris in sole, de lumine, quod ab aqua refulget, ignis accenditur etiam in durissimo frigore."

† Cavalieri was born in Milan in 1598; he died in 1647. The above is extracted from a work entitled "Lo specchio Ustorio: onero trattato delle settioni Coniche et alcuni loro mirabili effetti intorno al lume, caldo, freddo, suono, et moto ancora." Bologna, 1632.

As regards the air thermometer I am inclined to think that Galileo invented it about the year 1597; some attribute it to Sanctorio of Padua, others to Cornelius Drebbel of Alcmaer, while others, again, maintain that it was discovered by each of these men independently of each other. Some of the members of the Accademia de Cimento first constructed a fluid thermometer in 1655 or 1656. Edmund Halley introduced mercury in the place of alcohol. Otto von Guericke was the first to take the freezing of water as the lowest limit of the scale, while Renaldini, in 1694, proposed the boiling and the freezing points of water as the opposite limits of the thermometric scale. A kind of rude differential air thermometer is mentioned by Sturmius in his *Collegium Experimentale sive Curiosum* (1676). Sir John Leslie described the differential air thermometer which bears his name, in 1804, in his "Experimental Enquiry into the Nature and Propagation of Heat."

Leslie's principal work is his "Essay on Heat," in which he described the radiative and absorptive power of various substances, and determined the laws which regulate the radiation of heat. He maintained, however, that air is as essential to radiation as it is to convection.

The subject of the conduction of heat was discussed at some length by Lambert in his "Pyrometrie" published in 1779, but the earlier mathematical treatment of the subject is due to Fourier, and is detailed in a paper entitled "Théorie Analytique de la Chaleur," communicated to the Académie des Sciences in 1807. His definition of conductivity is extemely lucid, and he has treated of the cooling of an uniformly heated sphere with great ingenuity and elaboration. Poisson and Carnot have also applied the higher mathematics to the elucidation of various questions connected with the science of heat, and in our day Helmholtz, Clausius, and Thomson.

Mariotte and Hooke observed that glass cuts off many of the rays of radiant heat. M. De la Roche discovered in 1812 that radiant heat which has passed through glass has lost the rays which glass most readily intercepts, and that, as the temperature of the radiating source rises, so does the readiness of the radiant heat to pass through glass increase. Nobili and Melloni worked together on the subject of radiant heat. The former invented the thermopile, while the latter made the important discovery that rock-salt is very transparent to all kinds of heat, and that, by using lenses and prisms of rock-salt, dark heat rays may be refracted exactly in the same manner that light is refracted by glass. These results were published in the celebrated treatise entitled "La Thermochrose, ou la Coloration Calorifique," and were at first received with some credulity by the Parisian *savans*.

The most notable experiments in connection with the polarisation of heat were made by Bérard in 1812 (*Mémoires d'Arceuil*, vol. 3), and later by Forbes.

The Abbé Rochon endeavoured to determine the comparative heating effects of the various coloured rays of the spectrum as early as the year 1776; he employed a flint-glass prism and an air thermometer, and reckoned the heating power of the red rays to be about eight times greater than that of the violet. In 1798 Leslie (?), by using a differential air thermometer, found the calorific energies of blue, green, yellow, and red to be as 1 : 4 : 9 : and 16. In 1800, Sir William Herschell employed a small mercurial thermometer for the same purpose, and arrived at the conclusion that the hottest part of the spectrum is beyond the red rays. A detailed account of recent research on this subject (especially of the "long spectrum of the electric light") will be found in Tyndall's work "On Heat treated as a Mode of Motion."

The history of heat theories has not been alluded to above because the history of the kinetic theory was discussed at some length in the first of the foregoing lectures,* and I have elsewhere† treated of one of the phases of the material theory. Bergman's *De Materia Caloris* may also be consulted by those who are interested in this part of the subject. Of recent works on Heat I would specially mention Clausius "On the Mechanical Theory of Heat;" the treatise of Tait "On Thermodynamics;" the *Théorie De la Chaleur* of M. Desains, and the *Thermodynamique*, of M. Bertin.‡

It is hoped that the above facts—desultory though they be—may be of interest to those who desire to follow the literature of the science of Heat in greater detail than is possible in lectures, which are rather for purposes of demonstration than for the discussion of facts connected with the history of a science.

THE LATE DR. THOMAS GRAHAM, MASTER OF THE MINT.§

On Thursday, September 23rd, the remains of this distinguished man, attended by a number of his sorrowing relatives and personal friends (among the former of whom were his sister, her husband, and family), were conveyed to their last resting place in the High Church Burying Ground, Glasgow.

But few persons were privileged to any intimate acquaintance with Dr. Graham. He was never strong enough physically to allow him to mix much with society; he was always, or with rare exception, strong enough to toil in the field of science. Even scientific men, owing to his retiring habits, have not seen so fully the bearing of his labours, as they have seen of that of others in kindred pursuits, which will have much less influence. The reason of this will be at once apparent when we consider that he never pursued a merely popular or fashionable subject of investigation, and that he never sought a fashionable assembly in which to disclose the results of his labours, nor did he ever leave his own field of inquiry, although all the highways around him were bustling and busy, and if any person occasionally ventured near him it was only to find that there was nothing to be seen till he pointed something out. We do not pretend to be able to see and appreciate the entire significance of his scientific life—it would for this require much more study than we have given to it—and it will probably require many years for scientific men to develop the ideas originated by him. We can only endeavour to picture to ourselves the scene as he found it, and again as he left it touched by his master hand. Picturing in this connection is scarcely the right word — slight sketching is a phrase too strong for all that we can here attempt.

The general mind of the time has not yet arrived at a right apprehension of chemistry proper. The pre-

* Chemical News, vol. xx., p. 13. (*Am. Repr., Sept.*, 1869, *p.* 129).

† "On the Theory of Phlogiston," *Philosophical Magazine* for January, 1868.

‡ The last two treatises are published in the *Recueil de Rapports sur l'état des Lettres et les Progrès de Sciences en France*, a series of which it would be difficult to speak too highly.

§ Communicated.

vailing notions on the subject, even among well-educated persons, relate to the chemistry of a byegone time, and belong rather to the end of the last century than to the science of the present day. In that earlier time, the elements or simple bodies had been increased in number, and it was that there existed numerous bodies hitherto unsuspected. England had proved the existence of many of these elements, France had arranged them, adding more, and giving a theory of their action, and making a preliminary science from the materials thus created. Lavoisier saw first the qualities of combinations made by metals and other solid bodies with gases, and gave us a definite and clear nomenclature for the science. Wenzel and Richter tried long to make it clear that the constituents of substances must be proportionate and definite, but it did not appear possible to perceive by what innate process these proportions could be produced, and the whole question seemed to involve an impenetrable natural mystery. Dalton, in the simplicity of his mind, looked on matter as composed of exceedingly small bodies, probably round in form, like those conjectured by his great predecessors, from Leucippus to Newton, and thought that if we have one substance represented by black marbles, and another substance by white marbles, neither of which could be broken or divided, we cannot help forming definite compounds in chemically uniting them. That great idea of Dalton has been at the root of all advance in the science, and if any analysis is in contradiction to it, we at once deem it incorrect. When Dalton was publishing his opinions Graham was born, and it seems that from very early manhood it had been his desire to know more of the movements of these atoms. In a paper by him as early as 1829, he showed that diffusion of gases takes place among ultimate particles or atoms, and not between sensible masses. This, then, was a new step. Dalton had shown why they combined in different proportions, Graham showed that there was another property, a distinct movement—a vitality, so to speak, among the atoms. If, as Graham found, gases diffused through porous substances, such as he operated with, they were not driven forward mechanically, so that the mixture should pass like water, but the diffusion volumes are inversely as the square root of the densities of the gases employed in the experiment. If the gases were pressed out or expelled from the containing membrane, no air would return to supply their place; but it was found there was always an interchange of gases—for example, when hydrogen (contained in a tubular glass vessel having its open ends closed with stucco plugs), spontaneously passed through the stucco, air passed in with a velocity denoted by 1277; if carbonic acid were used it passed out whilst air passed in with a velocity of 623 only. Chlorine being used, the air passed in with a velocity equal to 302. From these results Graham was led to believe in Dalton's idea that gases were as *vacua* to each other—an imperfect explanation of the phenomena—although it was empirically correct. In 1831 he said—"The law at which we have arrived, which is merely a description of the appearances, and involves, I believe, nothing hypothetical, is certainly not in accordance with the corpuscular philosophy of the day, and is altogether so extraordinary that I may be excused for not speculating further upon its cause till its various bearings and collateral subjects be fully investigated." Graham leant, however, to the belief that the cause was the existence of an attraction of the particles of one gas for the particles of another, an attraction existing on the surface of the gaseous molecules. This idea led him to study the diffusion of liquids. In this inquiry he came to the conclusion that "diffusion" is a property of a fundamental character upon which the properties depend, such as the volatility of substances. Liquid diffusion thus supplies the densities of a new kind of molecules. "The fact that the relations in diffusion of different substances refer to equal weights of these substances and not to their atomic weight or equivalents is one which reaches to the very basis of modern chemistry. In liquid diffusion we deal no longer with chemical equivalents or the Daltonian atoms, but with masses even more simply related to each other in weight than the former. Holding still by the chemical atoms we may suppose that they can group together in such numbers as to form new and large molecules of equal weight, or of weights which have a simple relation to each other. It is this new class of molecules which appeared to play a part in solubility and liquid diffusion, and not the atoms of chemical combinations." The vast importance of this conclusion, resting upon experimental evidence, every chemist will at once understand.

It will thus be seen that, after a struggle of twenty years, Graham was able to speak of chemical movements not essentially connected with the atomic theory of Dalton. Still, it must be remembered, that these are movements, not combinations. They had, however, an important bearing on decompositions produced by liquid diffusion.

It was in examining this question that he observed the low diffusive power of albumen compared to common salt, for example, and conceived a mode of proximate analysis for mixed animal fluids. Strange to say, he found this diffusive power of liquids was closely allied to volatility. This is due to a cause about the last that even cultivated people generally would have imagined. Diffusion, as practised, was simply the passage through a thin membrane of gelatinous matter, or, as we may say, of parchment-paper as the material used. By observing this he was able to divide bodies in solution into two classes, severally called by him "Colloids" and "Crystalloids." If a liquid containing examples of these two bodies were placed in a vessel, one side of which is of parchment-paper, whilst on the other or outside of it there was water, it was found that the crystalloid substance passed through the paper into the water, whilst the colloid substance remained. In his earlier papers on the diffusion of gases, he had shown that it was only in the hypothesis of self-motion that we could account for the motion of the air within the smaller vessels of the lungs, as they could not be inflated or filled by the action of the chest and diaphragm, which removed only about 20 cubic inches of air at a time, while there were 300 cubic inches of air to be filled and emptied. In this paper on diffusion, the passages of saline fluids through membranes are explained: and the separation of bodies in solution is also shown by a similar self-acting process. We cannot follow him further into his ideas respecting colloid substances, which, he says, possess *energia*. He regards these latter as being matter in a dynamical state, whilst crystalloids are matter in a statical or rest condition. Ever, we should observe, does Graham look at the ultimate properties of bodies; he keeps the atom in view, or, at least, the fundamental matter, and always finding some new property regarding it, freed from the thousand years of exhausted

speculation, but illuminated by experiment and answers obtained by such acute cross-questioning of Nature as no one before him, in that department, at least, ever equalled. We may say, further, without fear of contradiction, no one has succeeded, by such original paths, in obtaining an entrance into the domain of Nature. In speaking of diffusion through membranes, he makes it quite clear that the latter does not act as a filter. The substance is mechanically impenetrable: molecules pass through it, not masses. These molecules are moved by the power of diffusion. It was when examining the action of a septum of caoutchouc separating gases that his attention seems to have been called to the surprising passage of gases through the homogeneous substance of a plate of fused platinum, or of iron at a red heat, as discovered by MM. St. Clare Deville and Troost. He enquired if this had any relation to liquefaction, and concluded that such a term could only be applied in a vague way to bodies so elastic and volatile at an elevated temperature as the gases are, and hydrogen in particular. Still, since dissolving and liquefying must be allowed, with such a fact before us as silver retaining twenty volumes of oxygen at a red heat, Graham also believed that the absorption of gases by a liquid (such as carbonic acid by water) is not a purely physical effect. It appears to involve some relation in composition. In the composition of the bodies, he adds—"May a similar analogy be looked for of hydrogen to liquid on colloid bodies of the metallic class?" It was in following up this idea that he came to the conclusion that hydrogen might pass into metals, and form with them an alloy. This alloy he succeeded in making, and a medal of palladium and hydrogenium was struck in his honour. The hydrogen in this condition and connection was called hydrogenium, in order that the name might have a termination like the names of the metals which it resembled. The palladium contains nine hundred volumes of a substance so light as hydrogen, and so many thousand times lighter than itself. This brilliant discovery had other results. Iron was found to absorb gases when cooling; and it was, therefore, possible to know in what gas iron did cool by finding the gas shut up or included in it. The technical value of this may still be very great; but Graham cared little for such results. He sought cosmic truth; and he had a wonderful proof of his own correctness by the examination of cosmic phenomena. He found that the gas which was shut up in iron made by man was carbonic oxide, but the iron from space, or meteoric iron, contained hydrogen. This gas he took for us out of the meteoric iron, and burnt it. It was hydrogen. Strange that at that time a small star had increased in brilliancy, and become a large one. The spectroscopist found, by the evidence of the spectrum lines, that hydrogen was burning. Graham's quiet and, to all appearance, uninteresting, unimportant, and even dull, experiments, that nobody cared to share with him, had at last resulted in two of the most brilliant facts, which even cultivated minds must long wonder at and admire. Reference to one of his latest speculations must finish our present notice of this distinguished man. That gases have initial movements as one of their original properties, and that the speed of these movements severally may be their main distinction. This would take them out of the region of chemistry proper, and bring them into physics; but physics and chemistry are, after all, fundamentally one. A new field is unfolded to us; new work must be done, and new workers are required. Who among us will give up all the ordinary gratifications and amusements of life to work in this field like Graham? Who among his fellow chemists will do work worthy of being placed beside his? We may freely say that such another will not soon arise, and, if our country produces such a man in a century, she does her duty well, even if the rest are only of average powers.

We cannot go into the detail of the labours of Graham. We have left out his enquiries into the action of water, basic and constitutional, in chemical compounds; his able papers on the arseniates and phosphates; and we have said nothing of osmotic force by name; neither have we done justice to his enquiries on effusion and transpiration; but we have hastily, after his funeral, tried to remember the main points of a great scientific life, and we trust they will be more closely studied than heretofore by all scientific men. We are almost ashamed to allow such a meagre account to stand as representative of the labours of such a man; but it is only for a little, as a longer and more detailed life must soon be written by men who will give much time, care, and competent thought to every portion of the publication. We need scarcely speak of Graham in private. Such enquiries will always have one result in showing that he was pure-minded, just, generous, and kind-hearted to the uttermost. Humble he was, quiet, and as simple-minded to the last as if he were always the same hoping, trusting youth that he seemed to be when he first began to lecture in the Andersonian Institution thirty-nine years ago. By his death, Scotland has lost, at a somewhat early age, one of her brightest scientific names, and Great Britain and the world one of the greatest chemists of the present or of any period.

A CHEMICAL METHOD OF TREATING THE EXCRETA OF TOWNS.*

BY EDWARD C. C. STANFORD, F.C.S.

This paper is intended as a continuation of two former papers read before the Glasgow Philosophical Society, and published together in the Chemical News, under the title of "A Chemist's View of the Sewage Question."

In these papers, I have endeavoured to show that the water-closet system of disposing of human excreta, unless it undergoes some great modification, can never be regarded as the perfect system of the future. I have strongly urged the general adoption of the dry-closet, as avoiding all the great evils which are apparently inseparable from the use of water as a vehicle; and pointed out the use of charcoal, by which its application to towns and cities is simple and easy. Since these papers were published, further experiments have been made, which strongly confirm the opinions already advanced, and form the subject of this paper.

Amongst other objections to the use of water as a carrier, I have specified—

1. The enormous cost of the works required, in proportion to the small amount of noxious material to be removed.

2. The large annual outlay required to keep the closets in order. Experience, in large cities, has shown that, on this account, these closets are quite unsuitable for the dwellings of the poor.

3. The enormous amount of water employed (estimated at 365 times the weight of the excreta), where,

* Read before the British Association, Exeter Meeting, Section B.

as in many towns, there is much difficulty in obtaining it.

4. That it results in a subterranean flood of filthy water, which must flow somewhere; and, wherever it flows, it pollutes the region, thus disseminating and distributing the evil.

5. This material, worth about 30s. per ton, has its value reduced, by dilution, to 1d. per ton, which it is impossible, by any known chemical method, to extract with profit.

6. The large generation of noxious gases in the sewers, which constantly escape into our streets and houses.

In reference to the latter, Dr. Gairdner speaks strongly of almost all sewers, as "diffusing poisons upwards and downwards," and too often "carrying backwards, into the very heart of the dwelling, the reflux gases, the produce of the decomposition of the impurities of a whole neighbourhood."

Dr. Fergus characterises the sewers as "a gigantic laboratory under our dwellings," from which noxious gases escape, by gully holes into our streets and pipes into our houses.

He has furnished me with a number of extracts from eminent medical authorities, which conclusively show the highly dangerous character of the miasma occasioned by the infiltration of sewage water and the evolution of sewer gas.

Of these I shall only make two quotations, which should be sufficient to convince any one of the important bearing of this question on the national health:—

Extract No. I.

Mr. Simms's *Second Report* (1860) *of* Dr. Greenhorn's *Investigations in Several Towns in England.*

Pages 59 and 60.—"*Diarrhœal diseases* are increasing in this country; they vary in different districts, from 4 to 663 per 100,000 persons. If the diarrhœal death-rate of England generally were only ten times the minimum diarrhœal death-rate, there would be an annual saving in England of nearly 20,000 lives."

"In the districts which suffer the high diarrhœal death-rates, the population either breathes or drinks a large amount of putrefying animal refuse."

Page 61.—"If the diarrhœal death-rate of England is reduced to that which prevails among the healthier parts of the population, typhoid fever (now, probably, the cause of at least 15,000 annual deaths) will be reduced in more than equal measure; and in proportion as infantile diarrhœa is reduced, the convulsive disorders and respiratory inflammations of infancy (which now cause fully 60,000 annual deaths) will also show a large, if not equal, reduction of death-rate."

Page 64.—"The excess of mortality has, in all cases, been coincident with one or other of two local circumstances—(*a*). *The tainting of the atmosphere with the products of organic decomposition, especially of human excrement;* or (*b*), *the habitual drinking of impure water.*"

Extract No. II.

From Mr. Simon's *Ninth Report to the Privy Council.*

Pages 32, 33, and 34.—"*Cholera* derives all its epidemic destructiveness from filth, and especially from excremental uncleanliness."

"It cannot be too distinctly understood that the person who contracts cholera in this country is, *ipso facto*, demonstrated with almost absolute certainty to have been exposed to excremental pollution; that what gave him cholera was, mediately or immediately, cholera contagion discharged from another's bowels; that, in short, this diffusion of cholera among us depends entirely on the numberless filthy facilities which are let exist, and especially in our larger towns, for the fouling of earth, and air, and water, and thus, secondarily, for the infection of man with whatever contagion may be contained in the miscellaneous outflowings of the population. Excrement sodden earth, excrement reeking air, excrement tainted water; these are, for us, the causes of cholera. Cholera ravaging here at long intervals is not Nature's only retribution for our neglect in such matters as are in question. *Typhoid fever and much endemic diarrhœa are, as I have often reported, incessant witnesses to the same deleterious influence. Typhoid fever, which annually kills some* 15,000 *to* 20,000 *of our population; and diarrhœa, which kills many thousands besides.*"

Dr. Fergus has drawn attention to a remarkable but very common and fruitful cause of the escape of sewer gas into houses. He frequently noticed, when attending patients suffering from gastric fever, a peculiarly sickly and offensive odour, and in all cases traced it to the leaden syphons and soil-pipes of the water-closet. On examination, these were generally found to be perforated with holes, sometimes of considerable size, through which the sewer gases freely escaped into the house. The evil exists to an extent which will scarcely be credited by those who have not specially investigated the subject. A long length of soil-pipe will often be found bulged outwards in little swellings, each of which, sooner or later, open, and present apertures for the escape of sewer gas. If the pipe be laid, as it often is, under a bed-room floor, this may go on for years, until at last the pipe is taken up in a perfect honeycomb of deterioration; and we may pretty safely predict the sanitary condition of that bed-room and of its occupants. I have been informed by plumbers that it occurs most quickly where chloride of lime has been used; but the necessity for the use of this shows that the evil had existed before its application. The pipe becomes covered in the interior with a whitish-brown powder of which four specimens were examined; the composition is shown below:—

	I.	II.	III.	IV.
Carbonate of lead.....	2·70	86·00	91·00	92·90
Carbonate of lime....	80·63	2·50	2·10	2·90
Water.....	0·45	1·20	1·00	0·50
Lead insoluble as oxide	—	3·50	1·50	1 45
Silica.....	1·35	2·80	1·00	1·60
Organic matter.....	14·87	4·00	3·40	0·65
	100·00	100·00	100·00	100·00

The lead put down as insoluble is combined, apparently, with a kind of fatty acid, represented as organic matter. In No. 1, chloride of lime has evidently been recently used. The pipes are all taken from different closets, and arranged in an increasing order of deterioration. The action is probably caused by the carbonic acid, aided by the other gases of decomposition, and the fatty matter of the excreta producing carbonate of lead under somewhat similar conditions to those which obtain in its manufacture on the large scale; the carbonate of lime being derived from the solid excreta. This view requires confirmation; but one fact is obvious (and it is sufficient to show that the water-closet has been introduced before we have studied its effects)—that leaden pipes so much con-

demned for carriage of water for drinking purposes are even more unsuitable for house drainage; and the reason given explains, to a certain extent, what is generally admitted—that the common earthenware syphon forms the cleanest water-closet.

None of the disadvantages enumerated attend the use of the dry-closet; still less can any of these gigantic malaria evils result from its general adoption. It meets every sanitary requirement, which, after all, is the main consideration. Moreover, its machinery is simple and inexpensive. It effects at once a great saving of water; and it enables us to secure the whole of the value of the excreta. I have pointed out the only objections which can be urged against its application in large cities to be, when dry earth is used; the large amount required (three and a half times the weight of the excreta), the difficulty of obtaining such a supply, and the large cartage necessary: three and a half times the weight to be removed into the city, and four and a half times the weight to be carried out.

Now, by using charcoal, these objections are entirely removed; for it only requires one-fourth the quantity as compared to earth, and, by re-burning the charcoal, the supply is provided from the excreta itself; and the cartage is reduced to the weight of the material carried into the city, and twice its weight carried out. The quantity per diem for a population of 500,000 is calculated at 385 tons in, and 770 tons out; a quantity about the same in Glasgow as the city ashes.

Moreover, charcoal has other advantages over earth. It is a powerful deodoriser, and its employment guarantees a perfect immunity from odour quite unattainable by any water-closet; and it blackens and conceals the excreta so perfectly that no one seeing the product from the closets for the first time would have the least notion from its appearance what it was. As, also, the dust would always be sifted out for sale as manure, the charcoal used in the closets would always be of proper size, and no dust could be projected in the working of the closet. Such a closet could be kept in every bedroom without the possibility of becoming a nuisance, if only attended to; but, in houses constructed for the purposes, the closets on the several floors would be over one another, and the product from each fall through a 12-inch pipe to a small cesspit below the house, and this need only be emptied once a year. The small size of this pit may be imagined when it is mentioned that 1 cwt. of charcoal per month will be sufficient for each closet if used by six persons daily, and one cart load per annum will empty the pit.

Use of Charcoal in Latrines.—I have shown, in a former paper, how the use of seaweed charcoal in latrines effects its composition, by converting the carbonate of lime it contains into phosphate. The results published were from experiments with ten, twenty, fifty, and one hundred times its weight of urine evaporated down. I found that, though in all cases there appeared to be no appreciable loss of ammonia in drying, when the last product was re-burned alone, only half the nitrogen came over as ammonia, though the whole was obtained by soda lime. As, however, I propose for latrines the charcoal should be used ten times before re-burning, I have undertaken a complete series of experiments, the results of which are given in Tables A, B, and C, showing the composition of the chars after each re-burning, up to ten re-burnings and one hundred uses. The results are as regular as can be expected from the variable composition of the substance operated on. It will be seen that the residual chars rise, after five or six re-burnings, to about 25 per cent phosphate of lime, while the carbonate is reduced to 2 per cent. After having attained this composition at which it becomes regular, it would be advisable to add a certain proportion of fresh seaweed char, to prevent the phosphoric acid remaining soluble, of which a trace now appears, and to secure a regular supply of a good sugar refiners' charcoal, which would add a considerable value to it. In any case, the phosphate of lime thus gradually deposited is quite equal to a soluble phosphate for agriculture on account of its finely divided condition. The average yield of ammonia by simple re-burning is about equal to the calculated amount, and shows clearly that neither in the drying nor in the distillation has any been lost. The total yield is 3·16 per cent on the char, or 31·6 per cent for each re-burning. The total increase of char is 183 per cent, or 18·3 per cent for each re-burning.

The density of the char has increased 131 per cent in the ten re-burnings, the increase being merely in the first five re-burnings. The ammonia only was estimated in the destructive distillation. The increments of potash and phosphoric acid are pretty regular, that of sulphuric acid remarkably irregular. The commercial result of this process for latrines would be as follows:—Supposing the char sold as a manure after ten uses, 1 ton would produce, allowing 15 per cent for moisture, 30 cwts. of manure, containing nitrogen equal to 20 per cent sulphate ammonia, 7 per cent phosphate lime, and 5 per cent sulphate potash, and worth at least £5 per ton, or equal £7 10s., whilst it would have cost £2 for the char, 30s. for cartage, reckoned at 10 tons carted in and 20 tons carted out at 1s. per ton, or a profit of 80s. on each ton of char used. If, again, the char be used fifty times, and re-burned five times, its cost will be increased by cartage to £9 10s., and, by five re-burnings at 3s. 6d., to £10 7s. 6d., and in quantity, allowing 11 per cent for moisture, to 2 tons, the cost being thus £5 3s. 9d. per ton, and its value, containing 12 per cent phosphate lime, reckoned as insoluble, and 15 per cent sulphate of potash, is £5 per ton, in addition to which nearly 30 cwts. of sulphate of ammonia are yielded in the five re-burnings, worth, at 16s. per cwt., the sum of £24, less the cost of acid. If, however, the char be as good a sugar refiner as I suppose, its value will be much above that stated. In this case, however, the char would have to be washed, and the amount would be less by the amount of soluble matter it contains from which the potash could be separated. It would be easy, of course, to increase the soluble phosphate for some crops by the addition of mineral phosphate rendered soluble.

Use of Charcoal in Closets.—The experiments, the results of which are given in Tables D and E, were made with one of Smith's self-acting dry-closets, used by several lads.

No. 1 was distilled wet, Nos. 2 and 3 dry. After this, the charges were dried, and returned to the closet, and used again before being re-burnt. Nos. 8, 9, and 10 are complete analyses; and what is deficient in the others is calculated from these. A portion of the ammonia comes over combined with acetic acid, which is separately shown, and also the acetic acid as acetate of lime. The average results per deposit and per cent of wet and dry excreta are also shown. The composition of several of the resulting chars, and the increase per cent of the several ingredients, are shown in Table E. After No. 3, the compositions are pretty similar; and this may be taken, therefore, to be the char from ex-

creta. The char commenced with was only 3 lbs., or 48 ozs., to which 18 ozs. were afterwards added, the total amount employed being 66 ozs. At the end of the experiment, it amounted to 123 ozs., 57 ozs. being derived from the excreta; and yet this small original stock served 181 uses of the closet and absorbed 808 ozs. of wet excreta, having been dried and re used seventeen times, and re-burnt ten times. It increased about 66 per cent in density, then remaining constant, but was in every respect better adapted for the closet, and improved by the treatment, the charge being still under 8 ozs. at the end of the experiment. The distillation yielded over 38 ozs. of sulphate of ammonia, or nearly 7 per cent of the wet excreta. I propose that the mixture should be dried and re-used five times before being re-burnt: this has not been done in these experiments, as I was impatient for results. Where this is done, a considerable quantity of gas is given off in the distillation, and, from the large amount of fatty matter, it possesses considerable illuminating power. This fatty matter is characteristic of excreta, and is shown in the large quantity of tar yielded in the distillation—over 9 per cent; wood only yielding 10 per cent, and coal 12 per cent. The yield of ammonia equals 31 per cent of sulphate, showing this to be a most prolific source. It is remarkable that the re-burning shows the products of distillation of vegetable matter—acetic acid, for instance, combined with those

TABLE A.

Residual Chars.—Composition per cent.

	Ordinary Char.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Water	10·00	—	—	—	—	—	—	—	—	—	—
Soluble Salts	0·60	9·00	17·60	27·00	36·20	41·80	49·20	51·20	54·80	56·80	59·20
Insoluble	89·40	91·00	82·40	73·00	63·80	58·20	50·80	48·80	45·20	43·20	40·80
Soluble.											
Chlorine =	—	4·87	8·56	13·32	16·80	19·32	23·31	26·46	28·56	29·40	31·08
Chloride of sodium	—	8·11	14·26	22 17	28·00	32·20	38·83	44·00	47·60	49·00	51·80
Sulphuric acid	0·30	0·51	1·02	1·37	3·50	3·70	4·11	2·00	2·05	2·22	0·68
Phosphoric acid	—	—	—	—	—	—	—	—	trace	trace	trace
Potash	0·30	2·30	4·20	4·60	7·69	8·07	10·76	10·96	11·15	11·73	12·40
Insoluble.											
Carbon	54·40	40·00	40·60	35·80	32·20	33·20	26·20	26·00	23·40	23·40	23·40
Silica	9·10	12·40	12·40	11·20	8 80	6·20	6·20	5·60	5·20	4·40	3·20
Phosphate of lime	4·80	6·60	8·40	10·20	11·60	12·00	12·20	11·60	11·40	10·40	10·50
Carbonate of lime	17·40	24·20	15·60	11·60	7·40	3·60	2·80	1·20	0 40	0·40	0·90
Carbonate of magnesia	3·10	5·80	4·40	3·00	3·00	3·00	2·40	2·00	1·60	1·40	1·10
Specific gravity (relative)	1000	1254	1636	1659	1744	1822	1915	1995	2274	2294	2313

Washed Chars—Dry.

	Ordinary Char.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Carbon	61·12	44·94	49·87	49·71	51·11	57·24	52·40	55·31	54·41	58 59	59·24
Phosphate of lime	5·39	7·41	10·31	14·16	18·41	20·68	24·50	24·68	26·51	26·00	26·58
Carbonate of lime	19·55	27·19	19·16	16·11	11·74	6·20	5·60	2·54	0·93	1·00	2·28
Carbonate of magnesia	3·48	6·51	5·40	4·02	4·76	5 17	4·80	4·25	3 71	3·50	2·88

TABLE B.

Total Increase per cent on Original Char Used.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Dry solid matter	33·25	79·55	126·45	166·45	217·65	249·65	295·65	347·69	391·50	455·09
Char	6·20	23·08	44·71	59 65	80·61	98·48	116·88	136·68	154·24	183·40
Sulphate of ammonia	30·07	69·02	89·70	117·28	147·86	178·30	210·01	246·26	276·91	316·26

Residual Chars.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Water	—	—	—	—	—	—	—	—	—	—
Soluble salts	8·14	21·05	38·28	56·96	74·64	96·81	109·99	128·73	143·67	166·93
Insoluble	5·36	12·15	14·28	12·04	15·36	11.18	16·00	17·21	20·33	26·06
Soluble.										
Chlorine =	5·16	10·53	19·18	26 71	34·77	46·15	57·03	67·40	74·58	88·95
Chloride of sodium	8·59	17·53	31·92	40·52	57·96	76·88	95·04	112·33	124·46	146·59
Sulphuric acid	0 24	0·95	1·67	5·26	6·36	7·84	4 02	4·54	5·34	1·62
Phosphoric acid	—	—	—	—	—	—	—	trace	trace	trace
Potash	2·13	4·86	6·32	11·93	14·22	21·01	23·37	26·01	29·49	34·79
Insoluble.										
Carbon	*12·00	*4·47	*2·85	*3·31	5·36	*2·53	1·76	0·82	5·04	11·82
Silica	4 04	6·15	7·02	4·89	2·06	3·17	2·99	3·17	2·07	*0·05
Phosphate of lime	2·19	5·53	9·88	13·64	16·80	19·36	20·25	22·10	21·61	24·92
Carbonate of lime	8·25	1·78	*0·70	*5·64	*10·92	*11·86	*14·81	*16·46	*16·38	*14·86
Carbonate of magnesia	3·04	1·01	1·22	1 67	2·30	1·65	1·22	0 67	0·45	0·01
Specific gravity	25·40	63·60	65·90	74·40	82·20	91·50	99·50	127·40	129·40	131·30

* Decrease.

[English Edition, Vol. XX., No. 517, pages 198, 200.]

TABLE C.

Increase per 1000 Parts of Urine.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Average.
Dry solid matter	33·25	39·77	42·15	41·61	43·53	41·60	42·23	43·46	43·51	45·51	41·66
Char	6·20	11·54	14·90	14·91	16·12	16·41	16·69	17·08	17·13	18·34	14·93
Sulphate of ammonia	30·07	34·51	29·90	29·32	29·57	29·71	30·00	30·78	30·73	31·62	30·62

Residual Chars.

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	Average.
Water	—	—	—	—	—	—	—	—	—	—	—
Soluble salts	8·14	10·52	12·76	14·24	14·93	16·13	15·71	16·09	15·96	16·69	14·12
Insoluble	5·36	6·07	4·76	3·01	3·07	1·86	2·28	2·15	2·26	2·60	3·34
Soluble.											
Chlorine =	5·16	5·26	6·37	6·68	6·95	7.69	8·14	8·42	8·28	8·89	7·18
Chloride of sodium	8·59	8·76	10·64	10·13	11·59	12·81	13·58	14·04	13·83	14·66	11·86
Sulphuric acid	0·24	0·47	0·55	1·31	1·27	1·30	0 56	0·56	0·59	0·16	0·70
Phosphoric acid	—	—	—	—	—	—	—	trace	trace	trace	—
Potash	2·13	2·43	2·10	2·98	2·84	3·50	3·34	3·25	3·27	3·48	2·93
Insoluble.											
Carbon	*12·00	*2·23	*0 71	*0·83	1·07	*0·42	0·25	0·10	0·56	1·18	*1·30
Silica	4·04	3·07	2·34	1·22	0·41	0·53	0·42	0·39	0·23	—	1·40
Phosphate of lime	2·19	2·76	3·27	3·41	3·36	3·22	2·89	2·76	2·40	2·49	2·87
Carbonate of lime	8·25	0·89	*0·23	*1·41	*2·18	*1·98	*2·11	*2·06	*1·82	*1·48	*0·41
Carbonate of magnesia	3·04	0·50	0·40	0·42	0·46	0·27	0·17	0·08	0·05	—	0·59
Specific gravity	25·40	31·80	21·96	18·60	16·44	15·25	14·21	15·92	14·37	13·13	18·71

* Decrease.

TABLE D.

Results of Treating Closet Excreta.

No. of Expt.	No. of Deposits.	Weight, Wet.	Weight, Dry.	Char Used.	Char Produced.	Char, Increase.	Liquid Distilled.	Tar.	Acetate of Lime.	Free Ammonia as Sulphate.	Combined Ammonia as Sulphate.	Total Ammonia as Sulphate.	
		Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Ozs.	Grs.	Grs.	Grs.	Grs.	
1.	7	Estimated weight, 490 ozs.	Estimated weight, 110 ozs.	48·00	48·00	—	65·50	Estimated weight, 10 ozs.	Estimated weight, 1977 grs.	1229·00	Estimated weight, 1712 grs.		Partial Analyses.
2.	6			48·00	48·00	—	21·50			643·00			
3.	5			44·00	48·00	4·00	20·50			613·00			
	18												
4.	19			76·00	81·50	5·50	37·50			1310 00		11310	
	37												
5.	24			80·50	93·00	12·50	38·50			1721·00			
	61												
6.	24			93·00	104·00	11·00	34·50			1852·00			
	85												
7.	24			98·00	107·50	9·50	39·50			2230·00			
	109												
8.	24	113·00	36·00	104·50	111·50	7·00	53·50	2·50	479·60	1756·00	268·00	2024·000	Complete Analyses.
	133												
9.	24	93·00	18·00	105·50	108·50	3·00	34·50	2·50	503·60	1502·00	343·00	1845·000	
	157												
10.	24	112·00	18·00	98·00	102·50	4·50	33·50	1·50	300·80	1278·00	215·00	1493·000	
Total	181	808·00	182·00	795·50	852·50	57·00	379·00	16·50	Ozs. 7·46	Ozs. 32·32	Ozs. 5·81	Ozs. 38.130	
Average per deposit		4·46	1·00	4·39	4·71	0·32	2·09	Grs. 39·76	Grs. 18·01	Grs. 78·08	Grs. 14·02	Grs. 92·100	
Per cent, wet		100·00	22·44	98·43	105·62	7·19	46·86	2·04	0·92	6·24	0·71	6 950	
Per cent, dry		—	100·00	439·00	471·00	32·00	209 00	9·10	4·12	27·84	3·19	31·030	

Char dried and used seventeen times; re-burnt ten times. The distillations also produced about 1 oz. of light hydrocarbon.

TABLE E.

Analyses of Chars from Closet.

	Ordinary Char.	Composition. 1.	2.	3.	4.	5.	6.	Increase, per cent. 1.	2.	3.	4.	5.	6.
No. of Deposits		37	85	109	133	157	181	37	85	109	133	157	181
No. in Table D		4.	6.	7.	8.	9.	10.	4.	6.	7.	8.	9.	10.
Water	10·00	1·20	1·20	2·00	1·80	—	—	—	—	—	—	—	—
Soluble	0·60	4·70	9·20	8·30	10·10	9·20	9·60	4·10	8·60	7·70	9·50	8·60	9·00
Insoluble	89·40	94·10	89·60	89·70	88·10	90·80	90·40	4·70	0·20	0·30	*1·30	1·40	1·00
Soluble.													
Chlorine =	—	2·16	3·45	3·69	4·16	4·50	4·75	2·16	3·45	3·69	4·16	4·50	4·75
Chlorine of sodium	—	3·60	5·75	6·15	6·93	7·50	7·91	3·60	5·75	6·15	6 93	7·50	7·91
Sulphuric acid	0·30	0·85	1·00	trace	1·02	0 68	1·40	0·55	0·70	—	0·72	0 38	1·10
Phosphoric acid	—	trace	trace	trace	trace	trace	trace	trace	trace	trace	trace	trace	trace
Potash	0·30	0·30	4·10	3·46	3·46	4·61	5·57	—	3·80	3·16	3·16	4·31	5·27
Insoluble.													
Carbon	54 40	41·80	42·20	44·80	41·50	44 00	43·40	*12·60	*12·20	*9·60	*12·90	*10·40	*11·00
Silica	9·10	15·20	12·40	12·50	12·80	12·00	11·80	6·10	3·30	3·40	3 70	2·90	2·70
Phosphate of lime	4·80	13·50	15·60	20·00	21·06	21·20	21·40	8·70	10·80	15·20	16·26	16·40	16·60
Carbonate of lime	17·40	20·40	12·40	8 60	7 00	11·60	11·20	3·00	*5 00	*8·80	*10·40	*5 80	*5·40
Carbonate of magnesia	3·10	3·50	5·60	1 20	2·10	2·00	2·00	0·40	2·50	*1·90	*1·00	*1 10	*1·10
Specific gravity (relative)	1000	1319	1638	1720	1769	1700	1667	31·90	63·80	72 00	76·90	70·00	66·70

Washed Chars.

	Ordinary Char.	Composition. 1.	2.	3.	4.	5.	6.	Increase, per cent. 1.	2.	3.	4.	5.	6.
No. of Deposits		37	85	109	133	157	181	37	85	109	133	157	181
No. in Table D		4.	6.	7.	8.	9.	10.	4.	6.	7.	8.	9.	10.
Carbon	54·40	44·46	47·98	51·43	49·13	49·43	48·22	*9·94	*6·42	*2·97	*5·27	*4·97	*6·13
Phosphate of lime	4·80	14·37	17·41	22·96	24 93	23·34	23·77	9·57	12·61	18·16	20·13	18·54	18·97
Carbonate of lime	17·40	21 70	13·83	9·87	8·28	12 77	12·44	4·30	*3·57	*7·53	*9·12	*4·63	*4·96
Carbonate of magnesia	3 10	3·30	6·25	1·37	2·48	2·09	2·22	0 20	3·15	*1·73	*0 62	*1·01	*0·88

* Decrease.

from animal matter, as ammonia, for example, arising from the mixed nature of the human food. These experiments were conducted on excreta from poorly-fed lads: amongst good livers, the nitrogen, phosphates, and fatty matter would probably be much increased. These tables represent, therefore, the minimum yield. Taking these data, 1 ton of char which had been used five times would yield, allowing 15 per cent moisture, 48 ewts. of manure, containing nitrogen equal to 18 per cent sulphate of ammonia, 15 per cent phosphate of lime (reckoned as soluble), and 7½ per cent sulphate of potash, and worth £7 per ton. Its cost for char, £2, and for cartage, 5 tons in and 10 tons out, equal 15 tons at 1s., equal 15s. If advisable to hasten its sale by drying, it would cost 10s. more, the total cost being £3 5s., or about 28s. per ton. If re-burnt and returned to the closet, the re-burning would cost 3s. 6d. per ton, or 8s. 6d., and yield over 8 ewts. sulphate of ammonia at 16s., equal £6 8s. less cost of acid, and, allowing 10 per cent for moisture, 33 ewts. of char, partly to return to the closet and partly for sale as manure, and worth about £5 per ton. I think these data are sufficient to show that this process presents the means of recovering the total value of the excreta. In addition, there are other unexpected sources of further profit; for 100 tons of dry, solid excreta yield 9 tons of tar and 4 tons of acetate of lime, besides a considerable quantity of richly-illuminating gas.

I have brought this subject before the Section in the full belief that it must some day become a chemical question; and I maintain that engineers have shown their incompetence to deal with it alone. Water-closet excreta is now admitted to be the worst poison to put into our rivers; and why should such volumes of water be thus employed for such pollution? If this large amount of water be unnecessary, if, moreover, it be grossly wasteful and fearfully prejudicial to health, it becomes our duty to discuss any other method by which chemistry may be made available to secure that which has hitherto been lost. I repeat here my conviction expressed in a former paper—that "Every system of sewage, to be permanent, must give back to the soil that which in our food we have taken from it; and the mere ridding ourselves of a valuable fertiliser simply on account of difficulty in dealing with it is unworthy the enlightened spirit of our age." At the same time, I admit that considerations of health must always precede those of wealth in this respect, and no system need be spoken of against which there is a whisper of suspicion on this point.

Nothing can be said against the dry-closet in this respect. It has already become a recognised institution. It presents the best means at present known of confining a nuisance within its proper limits, instead of distributing it amongst our neighbours, and therefore merits our patient consideration.

There can be no doubt that, for country houses, the earth-closet is free from objection; but there is also no doubt that, with earth, it could not be applied to large towns; but, with the modification proposed, its use will be profitable in direct proportion to the size of the town. By its use we are enabled to store the manure for the farmer, and dispose of it when he wants it, and not whenever we want to get rid of it, which materially affects the market price.

While, therefore, there can be no doubt of the healthfulness of this process, I believe enough has been proved in this paper to show that the gradual introduction of char-closets will become national stepping-stones to health and wealth.

THE

CHEMISTRY OF THE BLAST FURNACE,

ACCORDING TO

MR. I. L. BELL'S EXPERIMENTS.*

BY CHARLES SCHINZ.

Mr. I. Lowthian Bell has lately read before the Chemical Society a paper on "The Chemistry of the Blast Furnace," this paper which is published in the Journal of the Society for June last, containing an account of a series of experiments which he has made on the process of the reduction of the iron ores in the blast furnace, and by means of which he intends to prove that this reduction takes place at a temperature much lower than that previously found by Scheerer, Ebelmen, and Tunner.

Mr. Bell comments at first upon the irregularity with which the layers in the blast furnace come down, and judges from that, that the volume of the blast furnace cannot be divided precisely into "zones." It should be stated, with regard to this, that it is absolutely wrong to charge a furnace with pieces varying much in size, this variation, of course, producing an unequal reduction and an irregular descent of the layers. But if this mistake is often made in England, it does not follow that the temperature in the blast furnace, with careful charging, should not decrease in an uniform and constant manner, so that it may really be divided into zones, limited by fixed temperatures: a difference of temperature is not even a necessary consequence of charging the furnace with pieces of unequal sizes, as the hot gases give up the heat with equal rapidity to large and small pieces, because this transfer depends simply upon the heat-conducting power of the materials. If, however, the free space between the pieces of the charge is not the same on both sides, the gases will rise much quicker on one side than on the other.

Of course small pieces of ore are more quickly and more completely reduced than larger ones, but large pieces, as well as small pieces, will be acted upon according to the existing temperature by the rising carbonic oxide; while, if they descend to such a depth of the furnace that the slag begins to run, the reduction ceases entirely, and afterwards it can only be accomplished, at a still higher temperature, out of the slag which contains oxide of iron by means of solid carbon. But that cannot influence the action of a zone of reduction, for the reduction by means of solid carbon is a different action, including other phenomena, and has to be examined separately.

If now the experimenters above named fixed the limits of their zones at very different heights of the shaft of the furnace, they have either erroneously taken the depth of the furnace as the extreme limit, whilst the volume of the zones ought to have been decided, or but very uncertain means of determining the temperature must have been at their command.

Mr. Bell has, on the other hand, put the ores to be reduced for a greater or less time into the iron pipes by which the gases are led from the furnace, and, moreover, into the pipes of furnaces of different size which, of course, give off gases of different temperatures; and, as he has thus found that a reduction takes place even at the melting point of bismuth (257° C.), he argues consequently that all that has been formerly stated about the temperature necessary for the reduction must be wrong. If Mr. Bell has really measured his temperature in a correct manner, of course then he is entitled to this conclusion; but it is a question whether Mr. Bell's measurement of the temperature does not depend upon a delusion. All compact metals possess a much greater heat conducting power than the ores. If we put upon the bottom of a gas-pipe pieces of ores and a piece of metal, the latter will not melt, for the atmospheric air cools the tube from below, and deprives the piece of metal which is in contact with the tube of the heat necessary for the melting, whilst the pieces of ores, with less conducting power, are exposed to a perceptible higher temperature.

If we suppose that the temperature of the pieces of ore was the same as that of the piece of metal which served for ascertaining the temperature, the conclusion at which Mr. Bell arrived is still only delusively correct, for the conditions of the chosen method of operating are different to those existing in the blast furnace. The quantity of gas passing through in proportion to the mass of ores is much larger in the pipe leading off the gas than in the shaft of the furnace itself. My own experiments (see *Documente Betreffende den Hokofen*) have proved that the reduction is as much accelerated by the proportionate quantity of gas as by the amount of carbonic oxide which these gases contain, and that the intensity of the reduction, therefore, depends together upon temperature, quantity, and abundance of CO, and that no comparable results can be obtained without taking into consideration, and without determining, all these three factors. The influence of the composition of the gases upon the process of reduction has been presumed by Mr. Bell, and he has, therefore, made special experiments with gases of the furnaces at Wrbna and at Clarence.

These gases have, according to Mr. Bell, the composition:—

$$13\,CO + H,\quad 16\,CO_2,\ 71\,N \text{ (Wrbna), and}$$
$$32\,CO + H,\quad 6\,CO_2,\ 62\,N \text{ (Clarence).}$$

But such a composition of blast furnace gases is almost impossible, for these gases must contain, if no direct reduction by means of solid carbon takes place, for 100 equivalent of nitrogen, 26·6 equivalent of vapourised carbon, and 26·6 equivalent of oxygen, plus the oxygen added by the reduction of the ores.

Now, the gases of the Wrbna furnace contain:—

$$13\,CO \text{ and } 16\,CO_2$$
$$6{\cdot}5 \quad " \quad 16 \quad = 22{\cdot}50\ O$$
$$\text{for } 100\,N \quad = 31{\cdot}69\ O;$$

the surplus of oxygen from the ores would thus be only—

$$31{\cdot}69 - 26{\cdot}51 = 5{\cdot}18;$$

well, but whence came the $16\,CO_2$?

$$\text{Besides } 13\,CO \text{ and } 16\,CO_2 \text{ contain}$$
$$6{\cdot}5 \quad " \quad 8 \text{ vols.} = 14{\cdot}5\ C.,$$

which gives 20·42 carbon instead of 26·51 for 100 N.

The result of Tunner's analysis is, therefore, decidedly wrong.

The composition given for the gases of the Clarence furnace, namely:—

$$32\,CO,\ 6\,CO_2,\ 62\,N,$$

is just as false.

These gases contain 22 volumes of O for 62 N, and this for 100 N = 35·48 O; next, also, they have 19 carbon for 62 N, or for 100 N there would be 30·64 carbon. The surplus of O thus equals 8·88 per cent, and of C = 4·04 per cent.

* *Engineering*, October 22, 1869.

[English Edition, Vol. XX., No. 518, page 205.]

The gases of Clarence Iron Works should have, according to Mr. Bell's own calculation, the composition—

Cold Blast.

Weight of carbon	32·79 = volume		30·48
" " oxygen	50·22	"	35·11
" " nitrogen	142·60	"	113·48

per 100 N = 26·86 C. / 30·94 O.

Hot Blast.

Weight of carbon	23·34=volume		21·76
" " oxygen	35·82	"	25·04
" " nitrogen	92·73	"	60·74

per 100 N = 35·82 C. / 41·22 O.

The surplus of oxygen would be, in the first case, 4·43 per cent, and in the latter case 14·71 per cent; the surplus of carbon in the first case, 9·31 per cent, and in the latter case, 0·35 per cent. But that does not correspond with the analysis which gives surplus of O =8·88, and surplus of C=4·04.

I only mention this examination of the analyses in order to show how easily such analyses are used for final conclusions, without proving whether they are really correct.

The incorrectness of these analyses had no influence upon the application which Mr. Bell has made of them. He intended to show with the first composition of gases that reduction still takes place even with a small proportion of CO, and that has really been the case; but not the least thing is proved by that, for oxide of iron when brought into contact at a sufficient temperature with gases which contain only a trace of CO, will change that CO into CO_2, if not as easily, at least as completely, as oxide of copper, which is used for ascertaining by means of combustion the quantity of CO contained in gases.

Mr. Bell next discusses the question, how the saving of fuel by means of a hot blast is to be explained. We have here especially to mention that with a cold blast an increase of the fuel will always produce a product richer in carbon and graphite, whilst an increase of the temperature by means of a hot blast will never secure the same success. This fact alone should have opened long ago the eyes of mining engineers as to the real cause of the effect of the hot blast; for if a hot blast effects a saving of fuel in the furnace, the disposable amount of carbonic oxide will be naturally much decreased, and the reduction as well as the carbonisation of the product, by that agent, will be prejudiced. But as all, or almost all, iron is gained from the ores by applying a hot blast, the reduction which cannot any longer be produced in a complete manner by carbonic oxide, must necessarily be effected by means of solid carbon. This is the solution of the problem relating to the wonderful effect of the hot blast.

The diagrams (deduced from Ebelmen) which Mr. Bell gives, and which show that with a cold blast CO appears only 5 feet about the tuyeres, whilst with a hot blast this height is increased to 9½ feet, lead to a very erroneous conception of the case. Although these results of Ebelmen were both obtained at Clerval, the construction of the furnaces differed very much from each other. The furnace of 1839 with hot blast had only a capacity of 11·27 cubic metres, whilst the capacity of the furnace of 1841 with cold blast was 23·98 cubic metres, and the total heights of these furnaces were only 8·67 and 10 metres.

Calculating now the volumes of the separate parts of the furnace, we find that in the one furnace, as well as in the other, with hot blast as well as with cold blast, carbonic oxide alone exists after the blast has passed through a fifth of the total capacity of the furnace.

113 kilos. of coals, requiring 3880 kilos. of air for their transformation into CO, are consumed per hour if a hot blast is applied. If these 3880 kilos. are heated to 182° C., 3880 × 0·24 × 182=169478 units of heat are introduced into the furnace, the heat representing $\frac{169478}{2404}$= 70·6 kilos. of coals.

The heat in the furnace corresponds thus with a quantity of coals equal to 113+70·6=183·6 kilos. If a cold blast is used, 153·5 kilos. of coals are hourly consumed. The quantity of heat in the furnace with a hot blast is thus greater by an amount equal to 183·6—153·5=30·1 kilos. of coals. Whereas the hot blast produces per hour only 85 kilos. of pig-iron, and the cold blast only 119 kilos.

The consumption of fuel in the furnace is thus per 1 kilo. of the product:—

$$\text{For a hot blast} = \frac{11}{85} = 1{\cdot}33.$$

$$\text{For a cold blast} = \frac{153\,5}{119} = 1{\cdot}29.$$

The latter system is, therefore, the most advantageous one, and the favourable effect of the hot blast disappears in the present case altogether. But the only reason for that is, that the capacity of the furnace with a cold blast is more than twice as great, as this increase of the capacity has the same effect as the hot blast.

Mr. Bell tries to prove the same thing in a different manner, but he makes from the beginning a mistake by supposing that equal quantities of heat must give the same results; his experiments are, therefore, in this respect without any value. It can also not be admitted that increase of the height of the furnace effects, under any circumstances, the same saving in the consumption of fuel as the hot blast. An increase of the height of the furnace, without altering the other dimensions proportionately, demands also a greater pressure of the blast, which can only be produced by an increase of power; but this increase of power requires for its generation also an increase in the consumption of fuel. Mr. Bell ought to have said that an increase in the *capacity* (instead of an increase in the height of the furnace) effects a saving.

But, also, an increased capacity of the furnace produces only then a saving of fuel equivalent to the hot blast, as at Clerval, if the hourly consumption of coal in the larger furnace is not greater than in the smaller furnace, as it was the case at Clerval, where the proportion of the consumption was $\frac{113}{153{\cdot}5}$ and that of the capacity $\frac{11{\cdot}27}{28{\cdot}98}$. Only in that case the capacity of the zone of reduction is increased in proportion to the ores passing through, and that is what has to be attempted in order to produce a cheap and, at the same time, good pig-iron.

ON THE SYNTHESIS OF GLUCOSIDES.

BY M. P. SCHÜTZENBERGER.

Ethers composed of sugar, and considered as polyatomic alcohols, are generally designated under the name of glucosides and saccharides. The synthesis of glucosides has only been effected at present with sundry organic monobasic acids (butyric, acetic, stearic, benzoic), by two methods.

1st. By the direct union of two compounds (sugar and hydrated acid), subjected to a prolonged contact and to a temperature of between 100° and 120° (Berthelot).

2nd. By the action of acetic anhydride upon sugar (Schützenberger). This latter method is less general than the former, but has the advantage of producing an entire transformation in a very short space of time.

My object has been to utilise the easy production of acetic derivatives from sugar, to prepare by double decomposition glucosides which are more complex, and whose composition more nearly approaches that of natural products, such as salicine, amygdaline, quercetine, rhamnine, &c. Here are the results of my researches.

1. Upon heating with benzine a mixture of soda-saligenine, $C_{14}H_{13}NaO_3$, and triacetic glucose at the boiling point of benzol, the following are formed:—Monacetic salicetine $C_{14}H_{11}(C_2H_3O)O_2$, glucate of sodium or an analogous salt, acetate of sodium, and a small quantity of a substance soluble in water, alcohol, benzol, precipitable by acetate of lead, and capable of being split up sharply into salicetine and glucose by boiling with dilute sulphuric acid. If triacetic glucose be replaced by diacetic glucose or diacetic saccharose, reactions of the same kind will be obtained. Under these conditions acetic sugar and soda-saligenine exchange their acetyle and their sodium, a small portion of the bodies present reacts in another way, producing acetate of sodium and a glucoside containing the elements of saligenine.

2. Better results are obtained by heating, in the presence of water, a mixture of acetic glucose and the plumbic compound of saligenine. The quantity of saligenic glucose thus formed is then much greater. I do not insist upon the centesimal composition of this product, as I have been unable to crystallize it, and do not know if it be a definite and unique compound.

3. An aqueous solution of acetic saccharose was heated with the plumbic compound of rhamnetine. The latter is perfectly insoluble in water, and yields on separation, rhamnegine, the colouring matter of buckthorn berries, acetate of lead, and a glucoside colouring matter soluble in water and alcohol, staining tissues yellow mordanted with alumina.

This glucoside colouring matter is precipitated by the acetate of lead which forms simultaneously; it is obtained in a state of purity by decomposing with sulphuretted hydrogen the yellow deposit remaining after the experiment. The soluble yellow pigment separates, upon boiling with diluted mineral acids, into glucose and insoluble rhamnetine.

4. Acetic sugars, amygdaline, salicine, acetic tannin, when heated with an aqueous solution of benzoate of soda, yield acetate of soda, and corresponding benzoic derivatives, of which more will be said at a future time.

The facts here stated prove that the method of double decomposition applied to acetic derivatives of sugar, has succeeded partially, and might, perhaps, serve for the synthesis of complex glucosides.—*Comptes Rendus.*

REPORTS OF SOCIETIES.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 5, 1869.

E. W. Binney, F.R.S., F.G.S., *Vice-President, in the Chair.*

"*On Nontronite*," by T. E. Thorpe, Ph.D., communicated by Professor H. E. Roscoe, F.R.S., &c.

There exists some doubt among mineralogists as to whether nontronite is to be regarded as a distinct mineral species. Owing to the difficulty of obtaining it in a fit state for investigation, the few analyses hitherto published by Berthier, Dufrénoy, Jacquelin, and others, have taught us but little concerning its real nature. The following analysis, made on a comparatively pure specimen, may throw additional light on the constitution of this compound. The sample analysed was discovered, unclassified, in the Mineralogical Cabinet at Heidelberg, and was stated by Professor Blum, who was disposed to regard it as pinguite, to have been found in the neighbourhood of Heppenheim, in the Bergstrasse.

1·4155 grms. of the substance was heated with fuming hydrochloric acid until the mineral appeared to be completely decomposed. The solution was evaporated to complete dryness, and the separation of the silica effected in the usual manner.

Silica obtained, 0.5680 grms.

The weighed silica was then dissolved in caustic potash, and proved to be entirely free from sand or quartz.

To the filtrate from the silica were added a few drops of nitric acid, the solution boiled, and the iron precipitated by ammonia.

Ferric oxide, 0·5757 grm.

The weighed precipitate was next dissolved in strong hydrochloric acid, water added, and the solution filtered from a minute quantity of silica which had escaped separation by the previous evaporation.

Silica (not completely separated), 0·0030 grm.

Caustic soda was then added in slight excess to the filtrate, and the ferric oxide again precipitated, washed, ignited, and weighed. The re-precipitated ferric oxide weighed 0·5740 grm. Hence the substance was free from any appreciable quantity of alumina.

To the ammoniacal filtrate a few drops of ammonium oxalate were added, and the precipitate ignited, and determined as caustic lime.

Lime, 0·0380 grm.

On adding sodium phosphate to the filtrate, a mere trace of magnesia, appearing only after the lapse of some hours, was found.

The remaining constituent (namely, water) was determined by igniting the mineral in a stream of dry carbonic acid, carefully freed from air, until the loss of weight appeared constant.

1·1205 grms. substance lost 0·2311 grm. water.

Calculated from the foregoing analysis, the composition of the mineral is as follows:—

Lime	2·68
Magnesia	traces
Ferric oxide	36·44
Silica	40·30
Water	20·98
	100·40

On subtracting the lime, which evidently may be regarded as an unessential constituent, the percentage composition agrees very well with that required by the formula $Fe_2O_3 3SiO_2+5H_2O$.

	Found.	Calculated.
Ferric oxide	37·24	37·20
Silica	41·29	41·86
Water	21·47	20·94
	100·00	100·00

Nontronite is evidently a product of the decomposition by weathering of some siliceous mineral rich in iron. It possesses a light green colour, which, on the expulsion of water, changes to a dark chestnut-brown. It is perfectly opaque, and shows no evidence of crystallisation. Its fracture is uneven, and the lustre of its streak resinous. It is

ictuous to the touch, and yields easily to the nail, and is somewhat harder than talc.

The following analysis by Biewend, made upon a specimen found at Andreasberg, agrees remarkably well with the foregoing determinations:—

Ferric oxide	37·30
Silica	41·10
Water	21·56
	99 96

Dr. Schunck, F.R.S., called attention to a paper by Vogelsang and Geissler, on the nature of the liquids enclosed in certain minerals, such as rock crystal, topaz, and quartz, which appeared in the number of *Poggendorff's Annalen* for last May. The authors find that these liquids (supposed by some observers to be hydrocarbons) always consist of liquid carbonic acid, mixed, in some cases, with a little water. The experiments by which they were led to this conclusion are fully described in the paper.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

In accordance with the generally expressed wishes of our friends and readers, we have endeavoured to effect arrangements to enable us to give, under the above heading, notices of every chemical paper in the world, *as soon as possible after publication. Whenever possible, these notices will appear in the form of carefully prepared, although necessarily brief, abstracts; as respects papers either too long or too abstruse to render condensation possible, their titles will be chronicled; and in all cases accurate reference will be made to the original publication. The two half-yearly volumes of the* Chemical News, *with their copious indices, will therefore be equivalent to an English edition of the "Jahresberichte," with the additional advantage of keeping the readers on a level with the latest advances of science.*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

The Saline Deposits of Turkestan.—M. Palm.—The author says that he was sent on a long journey through a very little frequented portion of the Asiatic part of the Russian empire, and that, during that time, he studied especially those saline deposits which are not chiefly composed of common salt, known by the German name of *salz-steppen*. The first deposit alluded to in this paper is met with near Fort Perowski, and consists of alternate layers of a saline mass and fine white sand, impregnated with a salt soluble in water. As instances of the composition of this salt, we quote the following analysis from this paper:—Percentical composition—NaO, 42·4; SO_3, 54·8; water, 2·0; sand, 1·0. Sulphate of soda, 47·215; common salt, 2·719: water, 48·50; sand, 1·566; formula—

$$NaO, +SO_3 8aq. + 1\text{-}14th\ eq. NaCl.$$

Sulphate of soda, 57·26; common salt, 10·18; water, 35·56; formula—

$$10(NaO,SO_3) + 2(NaCl) + 9HO.$$

The author describes very minutely these deposits, and a number of others, stating that several millions of tons of sulphate of soda are deposited in this far away region, inhabited only by a few Nomadic tribes, and by Cossacks, who do duty along the great roads as a military police.

Very Black and Very Cheap Ink.—M. R. Voigt.—Take 12 ozs. of extract of logwood, 1½ lbs. of best nutgalls, 1 lb. 6 ozs. of dried sulphate of iron (*sulphas ferri ustum*), 1 lb 1½ ozs. of senegal gum, 1 oz. of commercial sulphate of copper, ½ a drachm of corrosive sublimate, and 45 lbs. of water. The nutgalls, previously ground to a coarse powder, are macerated for four days with 12 lbs. of previously well boiled, and afterwards quite cooled, water, taking care to place the mixture in a cool place. The extract of logwood is also dissolved by itself in 12 lbs. of the same water; the previously dried sulphate of iron is dissolved by itself in 5 lbs. of that water; the sulphate of copper is, also, separately dissolved in ½ a lb. of water. The quantity of corrosive sublimate is, likewise, separately dissolved in 4 lbs. of the said water, while the gum is dissolved in 9 lbs. of that same fluid. Each of these solutions should be filtered, either through a very fine hair sieve, or through linen; and, after that, the solutions should be mixed together in the same order as they are here enumerated. The ink thus obtained should be bottled, and the bottles, after having been well corked, kept in a cool place. 1 lb. of this ink can, according to this author, be had for the low price of 6 kopéiks (about three farthings).

On Mercurialin.—M. Reichardt.—The preparation of this substance from the *Mercurialis annua* is given at length; it is a complicated process, requiring great nicety of manipulation. Mercurialin is an oily fluid, at first colourless, but readily becoming brownish tinged by the action of heat, as well as by simple contact with air; it is an alkaloid, exhibiting a strongly alkaline reaction to test paper. The formula of mercurialin, as deduced from its salts, is C_2H_5N. The author has studied a series of the salts of this substance, most of which salts crystallise, and some are capable of forming well-defined double salts.

Steam-Boiler Incrustations.—M. E. Wiederhold.—The author states that the hardest incrustations of this kind are formed when the quantity of carbonate of lime amounts to from 20 to 25 per cent of the entire mass. He has found by an experience extending over several years, that some kinds of clay, among these, the substance known as *kieselschiefer* (a peculiar fatty clay), when suspended in the water contained in steam-boilers, prevent the particles of carbonate and sulphate of lime dissolved in the water, even if the latter is very hard, to cling together, and become fixed to the sides of the boilers, forming there a hard incrustation. A series of experiments, made on purpose, and continued for a sufficient length of time to yield a reliable result, has fully proved that the addition to the feed-water of the steam-boilers of fatty clays, especially the kind known as fuller's earth, entirely prevents boiler incrustations, even where, of necessity, very hard water has to be used as feed-water. A loose, soft mud is deposited as soon as the motion of the water, due to the boiling, ceases on cooling. This mud readily runs off on opening the sludge-valve of the boiler.

Zeitschrift für Chemie, von Beilstein, No. 14, 1869.

This number contains only two original papers:—

Reduction-Products of Mononitroazoxybenzol.—G. A. Schmidt.—It appears that the author had been engaged with researches on this subject some eight years ago, but had not then gone very deeply into it. Meanwhile it was taken up by various other experimenters, and among them, also, M. Alexejeff, who wrote and published a monograph on the subject in the Russian language. This circumstance induced the author to resume his work; and he proceeds with the reduction of the nitroazoxybenzol as follows:—One part, by weight, of that material is dissolved into ten parts of strong and boiling alcohol. While boiling temperature is kept up, there is gradually added a strong alcoholic solution of sulphide of ammonium, in small quantities of from 2 to 3 c.c. at once, and this is continued until all nitroazoxybenzol is dissolved, and none of it appears to crystallise out on a few drops being taken out of the boiling fluid as a test and cooled down. The formation of analine and β phenyldiamin is in this way entirely prevented. To the liquid, after having been decanted from the precipitated sulphur, a mixture of weak spirit and excess of hydrochloric acid is added, whereby muriate of amidoazobenzol is formed; this is a solid substance, exhibiting crystalline form, and possessed of a violet-blue colour and metallic lustre. When to these yet impure crystals is added a little ammonia and weak spirit, there is obtained a golden yellow-colored crystalline mass, insoluble even in boiling water, but readily soluble in alcohol and ether; this pure material fuses at

127°. This muriate, or hydrochlorate, yields, on being treated with excess of ammonia, the amidoazoxybenzol, a solid substance fusing at 130·5°, comprised according to the formula $C_{12}H_9(NH_2)N_2O$, nearly insoluble in cold water, a little soluble at the boiling point of that fluid, and readily soluble in strong alcohol, ether, and benzol.

On Trinitroazoxybenzol.—G. A. Schmidt.—When azoxybenzol is treated with a mixture of nitric and sulphuric acids, a trinitro product is obtained. The author mixed, in a flask, 20 grms. of azoxybenzol with 200 grms. very strong nitric, and 100 grms. of concentrated sulphuric acids. The azoxybenzol dissolves without giving off red vapours (but becoming very hot, the mixture is to be poured into cold water immediately), and yields a bright yellowish crystalline mass, glued together by a resinous product. After having rubbed up with some water, and placed on a filter, washed and dried, the resinous matter is dissolved, and thereby the trinitroazoxybenzol obtained as a crystalline powder, insoluble in water, very difficultly soluble in alcohol and ether, and readily soluble in benzol. It is best purified by re-crystallising it from nitric acid of 1·38 sp. gr. wherein it is readily soluble on being boiled, and crystallises on cooling. It fuses at 152°, solidifies at 140°, and explodes rather sharply when heated more strongly. Formula, $C_{12}H_7N_5O_7$. The resinous matter referred to contains binitroazoxybenzol, or isomeric substances, researches about which still occupy the author.

Comptes Rendus des Séances de l'Académie des Sciences, September 13, 1869.

This number, an unusually small one, contains, among its most remarkable communications, the startling intelligence that the manuscripts and signatures, about which M. Chasles has made so much fuss, are nothing but the work of a clever forger, who, by dint of study and perseverance, has been enabled to carry on a very successful, but, happily, now interrupted, business. M. Dumas read a small portion of a lengthy memoir on the—

Spectrum of the Solar Spots, as observed by the Rev. Father Secchi, S. J.—This paper, and the following, on the—

Constitution of the Luminous Spectra (M. Lecoq de Boisbaudran) are too lengthy, on the one hand, and too concisely written, on the other, to admit of any useful abstraction.

Researches on the Nature of the Products of Fermentation of Glycerine produced by Microzymas.—M. Béchamp.—The author briefly reviews the labours of M. Redtenbacher on this subject, stating that that chemist had transformed glycerine, after addition of beer yeast, into propionic acid. The author of this paper has applied to his researches a mixture consisting of pure glycerine, 250 grms.; chalk, from Sens, full of well and lively-moving microzymas; hashed mutton, quite fresh, and previously washed with cold water, 30 grms.; cold water, 3000 c.c. This mixture has been kept at a temperature of from 35° to 40° for several months. The chief results obtained by the author are, that propionic, butyric, caproic, and valeric acids are formed most abundantly; among the gaseous products, carbonic acid, hydrogen, and nitrogen are found as result of this fermentation.

September 20, 1869.

This number contains the following original papers relating to chemistry or sciences allied thereto:—

Preparation of Nitrogen.—Mr. Calvert.—The author suggests that a mixture of hypochlorite of lime and sulphate of ammonia be made in the following manner:—200 c.c. of an aqueous solution of hypochlorite of lime, containing 5·14 of hypochlorous acid, to which is added, 1·146 of sulphate of ammonia, previously dried at 220°; nitrogen gas is immediately given off, even without the application of heat, but it is better to apply heat very gently. The author observes, further, that all nitrogenised animal matters (such as albumen, fibrin, gelatine, silk, feathers, and skin) yield, when mixed with a solution of hypochlorate of lime, especially when heat is applied, a large quantity of nitrogen and carbonic acid. Ulterior researches on this subject are promised.

Researches on the Microzymas of the Blood and on the Nature of Fibrin.—MM. Béchamp and Ester.—This is, strictly speaking, a physiological paper. It is somewhat curious to learn that the coagulation of blood should be due to the juxtaposition and agglutination of minute globules (not the blood corpuscles) and that these globules should be microzymas, and capable of effecting the saccharification of the starch.

Heat Emitted from the Moon.—M. Marié-Davy.—According to the very accurate researches and experimental observations of this author, the heating power of the rays of the moon is incapable of raising the one-millionth part of a degree the temperature of a very sensitive air-thermometer covered with lampblack. This result disagrees with the results obtained by Lord Rosse, when he made observations on this subject.

New Kind of Gunpowder.—M. Brugère.—The author mixes 54 parts of picrate of ammonia and 46 parts of nitrate of potassa; on burning off, this mixture only leaves carbonate of potassa. The following formula explains the reaction:—

$$C_{12}H_2(NO_4)_3NH_4O_2 + 2(KO,NO_5) = 10CO_2 + 6N + 6H + 2(KO,CO_1).$$

The author states that this powder presents the following advantages over ordinary powder:—It is more homogeneous, and its effects are consequently more regular; it is far less hygroscopic; it is more effective for equal weights; and it leaves far less solid matter on combustion. The residue left after combustion does not affect metals, since it is only carbonate of potassa; this powder hardly emits any smoke at all, and what little is emitted is devoid of smell. The author recommends a mixture of 25 grms. of picrate of ammonia, 67 grms. of nitrate of baryta, and 8 grms. of sulphur, as an excellent substitute for Bengal light, and as suitable for signal and port lights, and use in theatres, since hardly any smoke is emitted and no unpleasant smell given off, while the light is very brilliant, slow burning, and yields a beautiful greenish tinge.

Annalen der Chemie und Pharmacie, July, 1869.

This number contains the following original papers:—

New Mode of the Formation of Nitro-Prussides.—M. Städeler.—The author begins this monograph by a lengthy description of the manner in which he ascertained the composition of the orange-coloured precipitate which ensues when a solution of cyanide of potassium is added to a solution of a proto-salt of iron. The quantitative estimation of the proportions of the proto-salt of iron and of the cyanide of potassium were found to be in relation as 3:4, or 4:5; the formula for the orange-coloured precipitate alluded to is, accordingly, Fe_2Cy_5K. In order to test the accuracy of this formula, the author tried to convert the orange-coloured precipitate into a nitro-prusside, according to this schematic formula—

$$Fe_2Cy_5K + NO.OK = FeO + Fe(NO)Cy_5K_2.$$

The result of experiment confirmed the correctness of the author's opinion; but the reaction was not found to take place so simply, for, instead of the formation of protoxide of iron and nitro-prusside of potassium, there is formed magnetic oxide of iron and the nitro-prusside; the formation of the nitro-prussides without acids is, therefore, the author's discovery. The orange-coloured precipitate above alluded to is converted into nitro-prusside by being treated with nitrite of potassium, best, after that orange-coloured body has become oxidised, by exposure to air. A portion of the paper is devoted to the discussion of the correctness of the for-

mula generally adopted for nitro-prussides, and due to Gerhardt's researches on this subject.

On Anisaldehyde.—Dr. Rossel.—The author first reviews the labours of MM. Cahours, Piria, Canizzarro, Bertagnini, and others, on this subject. The author states that the anisaldehyde is best prepared by mixing 1 part of essential oil of anise, 2 parts of bichromate of potassa, 3 parts of concentrated sulphuric acid, and 8½ parts of water. When 100 grms. of the essential oil are operated upon, about 50 per cent of aldehyde is obtained. The raw product, after having been purified, exhibits a nearly colourless fluid, of 1·1228 sp. gr. at 18°; it is readily soluble in alcohol and ether, but not so in water; its reaction is neutral, but, since it oxidises very readily to anisic acid, a few drops of the aldehyde, on exposure to air, become solid, and, at the same time, exhibit acid reaction to test-paper. This aldehyde is composed of $C_8H_8O_2$. The author has succeeded in obtaining the several derivatives from this anisaldehyde, among which are anisoine, $C_{16}H_{16}O_4$, a solid substance crystallising in six-sided prisms, hydranisoine, isohydranisoine, desoxyanisoine, and anishumine.

On Diphenyl.—M. Brönner.—While engaged in rectifying a large quantity of benzol, made by the distillation of a mixture of benzoate of lime and slaked lime, there remained in the retort a solid crystalline substance, which was found to be insoluble in water, and readily soluble in ether and in boiling alcohol, from which latter solution it was obtained in a pearly, crystalline mass, fusing at 70·5°, and which, on being submitted to elementary organic analysis, yielded results leading to the formula, $C_{12}H_{10}$—that is to say, the same as the substance M. Fittig obtained by acting with sodium upon monobrombenzol. The reactions of the latter substance, as described by Fittig, and tried by the author of this paper, with the substance obtained by him in the manner above described, agree in all respects; and there is no doubt, therefore, that both materials are identical, and deserve to bear the same name.

Relations existing between Amylen and Oil of Turpentine.—Drs. Bauer and Verson.—The chief leading points of this memoir may be summarised thus:—1st. Two molecules of amylen form one molecule of diamylen—

$$C_5H_{10}+C_5H_{10}=C_{10}H_{20}.$$

2nd. Diamylen and bromine form diamylen-bromide; and this last-named substance forms rutylen, when it is treated with an alcoholic solution of caustic potassa—

$$C_{10}H_{20}Br+2KHO=2KBr+2H_2O+C_{10}H_{18}.$$

3rd. Rutylen forms, with bromine, a bromide of rutylen, and this, on being treated with an alcoholic solution of caustic potassa, yields the new hydrocarbon—

$$C_{10}H_{18}Br+2KHO=2KBr+2H_2O+C_{10}H_{16}.$$

$C_{10}H_{16}$ is evidently related to tereben, which, as observed by M. Berthelot, is the "terme commun et stable auquel tous les carbures, $C_{10}H_{10}$, viennent aboutir."

Products of the Action of Chlorous Acid upon Naphthaline.—M. Hermann.—The products obtained by this reaction are—An acid containing chlorine, phthalic acid, the acid potassa salt of a new sulpho-acid, and bichloride of naphthalin. The author describes these products, and many of their combinations, at great length. The formula of the chlorine containing acid is $C_{10}H_7ClO_5$; this acid readily forms salts, most of which crystallise. The bichloride of naphthaline, $C_{10}H_6Cl_2$, is a solid crystalline substance, fusing at 68°, and soluble in alcohol. The new sulpho-acid above named is *Naphthochinonsulpho acid*, the potassa salt of which contains, in 100 parts:—Carbon, 36·73; hydrogen, 1·22; potassium, 12·00; chlorine, 10·87; sulphur, 9·79; oxygen, 29·39. Formula, $C_{10}H_4KClSO_6$.

Specific Heat of Saturated Vapours.—M. J. A. Groshans.—This paper, a very learned essay on this subject, being entirely based upon higher algebra, is not well suited for abstraction.

Some Derivatives from Creosol.—M. Biechele.—The author first reviews the labours of Hlasiwetz, Hugo Müller, Gorup-Besanez, Sobrero, and others, on this subject; and then he describes a series of his own experiments, treating first on creosol-potassium—

$$C_8H_9KO_2+2H_2O.$$

Creosol, obtained by decomposing the salt just named by means of sulphuric acid. The substance thus obtained is, after purifying, a colourless, oily liquid, highly refractive, boiling between 209° and 220°, becoming a solid mass when treated with ammonia, and reducing salts of silver to the metallic state; formula, $C_8H_{10}O_2$. Creosol-sulpho acid.—The result of the action of sulphuric acid upon rectified creosote is a liquid readily absorbing water from the atmosphere; its formula is $C_8H_9O_2.SO_3H$. This acid forms, with baryta, oxide of lead, and potassa, salts readily soluble in water. When chloride of phosphorus acts upon creosote, the chloride of creosol, C_8H_9OCl, is among the products.

Action of Hypochlorous Acid upon Butylen.—M. Lieben.—By this reaction, butylen-chlorhydrin, chlorinated dibutylen-chloride, are obtained; but the very concise description given by the author, of a long series of rather complicated chemical operations, cannot be readily condensed. The formula of chlorinated dibutylen-chloride is—

$$\left\{\begin{matrix} C_4H_8Cl \\ C_4H_7Cl.Cl \end{matrix}\right.$$

Since the oxidation of an alcohol obtained from butylen-chlorhydrin yields acetic acid, the author states as his opinion, based upon his researches, that the alcohol just alluded to is ethyl-methyl-carbinol.

The two remaining papers in this number are taken, one from the *Proceedings of the Royal Society*, the other from the *Comptes Rendus*, and have both been already abstracted in our pages.

August, 1869.

This number contains the following original papers:—

Amines of Xylyl-Alcohol.—Dr. O. Pieper.—Chlorine gas is first passed into boiling xylol, and the chloride so formed is treated at 116°, in sealed tubes, with a strong solution of ammoniacal gas in alcohol. The contents of the tube, after the reaction was finished, was treated with alcohol; and this fluid, along with excess of ammonia, was removed by distillation. The author thus obtained trixylylamine, $(C_8H_9)3N$, a colourless, viscous, oily fluid, specifically lighter than water, not soluble in that fluid, difficultly soluble in alcohol, but readily soluble in ether. Hydrochlorate of trixylylamine, $(C_8H_9)3N,HCl$, a solid substance, exhibiting perfectly snow-white needle-shaped crystals, not soluble in water and ether, difficultly soluble in cold, but readily in hot alcohol, and fusing at 212°. Bixylylamine, $(C_8H_9)2HN$, a somewhat yellowish coloured oil, exhibiting an alkaline reaction to test-paper, specifically lighter than water, insoluble therein, soluble in alcohol and ether, and decomposed if heated above 210°. Xylylamine, $(C_8H_9)H_2N$, also an oily liquid, boiling at 196°, soluble in alcohol and ether, and insoluble in water; it attracts carbonic acid from the air, and solidifies.

Decomposition of Tri- and Bi-Benzylamine by Heat.—Dr. L. Brunner.—The author divides his essay in two parts, treating in the first on the products of distillation of tri- and bi-benzylamine. Among the fluid products is toluol, boiling at 112°. Among the solid products, dibenzyl, $C_{14}H_{14}$, obtained, after re-crystallisation, in large foliated shiny crystals fusing at 52°; toluylen, $C_{14}H_{12}$, a solid body, fusing at 120°. Among the residues of the distillation, left in the retort, and treated of in the second part of this essay, we notice lophin, $C_{21}H_{16}N_2$, a solid body, crystallising in needle-shaped crystals, fusing between 260° and 270°. When lophin is placed in a current of dry hydrochloric acid gas, and a dry current of carbonic acid gas passed over it, the compound $C_{21}H_{16}N_22HCl$ is formed.

Amines of Chlorinated Benzyl-Alcohol.—M. Berlin.—By a complicated process, described at too great length for any useful abstraction, the author has obtained a series of chlorinated compounds, and combinations of these with other substances. We notice among them—Chlorinated tri-benzylamine $(C_7H_6Cl)3N$, a solid substance, soluble in alcohol, and fusing at about 89°. Chlorinated bi-benzylamine $(C_7H_6Cl)_2HN$; the author discovered no less than four varieties of this base, designated, respectively, *a*, *β*, *γ*, and *δ*, and studied the salts they form. Chlorinated benzylamine, $(C_7H_6Cl)H_2N$, a colourless liquid, readily soluble in alcohol and ether, but not in water; it attracts carbonic acid from the air, and is thereby converted into a solid substance.

Variable Behaviour of Iodine towards Hydrosulphuric Acid under Divers Conditions, and the Causes thereof.—M. A. Naumann.—This essay treats on the part water (and what the author calls thermochemical action) plays in the reactions between iodine and sulphuretted hydrogen gas. Dry sulphuretted hydrogen and iodine, dissolved in anhydrous sulphide of carbon, do not act at all upon each other; neither does sulphuretted hydrogen act upon solid iodine, or vapours thereof if water is excluded. The greater portion of this essay is not well suited for abstraction.

Researches on Phloron and Cresol, and some of their Derivatives.—A. von Rad.—This is a lengthy monograph on the subject named; the mode of treatment and the concise manner in which it is written make it unsuitable for condensation.

Conversion of Urea into Carbaminic Acid.—M. H. Bunte.—About 8 grms. of nitrate of urea were mixed with absolute alcohol, and heated in a sealed tube, for some hours, at about 130°. The contents of the tube, which had nearly become solid, were dissolved in water, next treated with ether, and, after more purifying, a substance was obtained yielding, on elementary analysis, results leading to the formula $C_3H_7NO_2$. The remainder of this paper is devoted to a lengthy theoretical discussion on the various methods to ascertain the true nature of *substituted* ureas.

Condensed Ureas.—M. Schiff.—The author describes, at great length, a number of compounds which he calls *condensed ureas*, and which are made up according to the general formula—

$$XCH_4N_2O+(X-1)CnHmO-(X-1)H_2O.$$

Since this paper is, *de facto*, an exhaustive monograph on this subject, it is difficult to give any furthur abstract of the details it contains.

Compounds of Ammonia and Sulphate of Zinc.—M. G. Müller.—The author gives the following results of analysis of compounds of sulphate of zinc and ammonia, percentically:—Oxide of zinc, 30·58; sulphuric acid, 30·18; ammonia, 25·65; water, 13·59. Formula—

$$1ZnO1SO_34NH_32H_2O.$$

Oxide of zinc, 26·91; sulphuric acid, 26·58; ammonia, 22·59; water, 23·92. Formula—

$$1ZnO1SO_34NH_24H_2O, \text{ or } \left(\begin{matrix}SO_2\\Zn\end{matrix}\right\}O_2,4NH_3),4H_2O.$$

Recovery of Nitrate of Uranium from the Phosphate of Uranium, and on a Nitro-Phosphate of Oxide of Uranium.—M. Heintz.—Since this paper bears upon a subject of importance to many chemists, and, since it is too lengthy for suitable abstraction, we intend to give it in full at a future period.

Chromate of Oxide of Zinc and Ammonia.—M. L. Bieler.—The author describes, at great length, the preparation of a salt composed, in 100 parts, of—Oxide of chromium, 33·01; oxide of zinc, 26·73; ammonia, 22.44; water, 17·82. This salt is readily soluble in dilute acids, crystallises, is decomposed by water, exhales ammonia constantly, and is, hence, readily and spontaneously decomposed.

Behaviour of Boracic Acid towards Oxide of Copper, Borate of Copper, and Ammonia.—M. Pasternack.—After reviewing the labours on this subject by MM. Tünnermann and Rose, the author records some experiments made by him in order to settle what compound is formed when a solution of two parts of sulphate of copper, and a solution of one part, by weight, of borax, are mixed, care being taken to pour the latter solution into the former. The mixture was next heated, filtered, and washed with warm water, whereby all the boracic acid was eliminated, and a salt left containing, in 100 parts—Sulphuric acid, 18·65; oxide of copper, 64·65; water, 16·79. To the filtrate obtained was added a fresh quantity of solution of borax. and a salt obtained containing, percentically—CuO, 52·72; B_2O_3. 18·59; H_2O, 28·69. A combination of boracic acid, ammonia, oxide of copper, and water, a true basic salt, had the following percentical composition:—CuO, 20·80; B_2O_3, 35·41; NH_3, 17·20; H_2O, 27·31.

Borate of Zinc and Ammonia.—M. Büscher.—This paper is analogous to the foregoing. The borate obtained consists, in 100 parts, of—ZnO, 20·40; B_2O_3, 35·27; NH_3, 17·13; water, 27·20.

Action of Acids upon Carbylamines.—This paper is not well suited for useful abstraction.

Synthesis of Paramonochlorobenzoic Acid.—M. C. Müller.—The acid just named is obtained in large quantity by the oxidation of chloride of benzol, after having been purified and dried over sulphuric acid. Paramonochlorobenzoic acid is a solid, fusing at 235°, readily soluble in alcohol and ether, but very difficultly soluble in water. Formula, $C_7H_5ClO_2$. Its baryta salt crystallises readily.

New Mode of Formation of Ethylsulphuric Acid.—M. Heusser.—By means of the action of sesquichloride of sulphur upon alcohol, and simultaneous exclusion of oxygen, the author has succeeded, by a method described at great length, in obtaining a baryta compound $(C_2H_5)Ba''S_2O_6(OH_2)_2$, which is ethyl-sulphate of barium. The paper discusses, at great length, the labours of MM. Carius, Warlitz, and others on this subject.

Nitride of Boron.—M. Darmstadt.—The author finds that this compound of boron and nitrogen can be readily obtained when one part of previously fused and powdered boracic acid, and about two parts of urea, are mixed and heated in a covered porcelain crucible, first more gently, at last to red heat. The fused mass is lixiviated with hot water acidified with a few drops of hydrochloric acid, in order to promote the deposition of the nitride of boron.

Journal de Pharmacie et de Chimie, August, 1869.

This number contains the following original papers:—

Magnetic Oxide of Iron and its Salts.—M. Lefort.—After briefly referring to the labours of M. Fourcroy, and other chemists of comparatively older date, the author describes, at some length, the preparation of the ferroso-ferric oxide of iron in the following manner:—100 grms. of pure sulphate of protoxide of iron is dissolved in a small quantity of distilled water previously freed, by long-continued boiling, from all air; 200 grms. of the same salt are placed in a suitable vessel, containing already 50 grms. of nitric acid and 50 grms. of water. This mixture is heated in a sand bath, until the whole of the sulphate of iron is peroxidised, and a dark brownish red liquid is obtained, which, after having become quite cold, is added to the solution of 100 grms. of sulphate of iron. The author next proceeds to make a boiling concentrated solution of either caustic potassa or soda, and, while this is kept boiling, the mixed solution of iron salts is cautiously added, drop by drop, to the alkaline liquid. In this manner a very beautiful magnetic oxide of iron is obtained, which, on account of its great density, is easily washed with previously well boiled, and still hot, distilled water. After washing, it should be carefully dried over sulphuric acid. After having been thus well dried, the author

found, on analysing it, that its composition corresponds to the formula $FeO+Fe_2O_3+HO$. When dried by means of heat, gradually applied, the water is eliminated, and oxidation at the same time sets in; and when the substance is entirely dry, it is, also, entirely converted into Fe_2O_3. The quantity of water contained in the air dried (over sulphuric acid) magnetic oxide, amounts to 7·20 per cent. The composition of the chloride of this magnetic oxide, a perfectly well-defined salt, is, in 100 parts:—Chlorine, 36·57; iron, 21·66; water, 41·77. Formula, $4Cl3Fe18HO$; or—

$$4Cl\left\{\begin{matrix}Fe\\Fe_2\end{matrix}\right\}+18HO.$$

The author has also succeeded in obtaining a sulphate; but the stability of these salts is, after all, very slight.

Synthesis of Phenol.—M. Berthelot.—The author has combined acetylen with fuming sulphuric acid, thereby forming acetylenosulphuric acid, which is not decomposed even by boiling water. The author has next prepared acetylenosulphate of potassa; and, on decomposing this salt, phenol was obtained in large quantity. Acetylenosulphuric acid should not be confused with acetylsulphuric acid, which is a totally different body, and readily decomposed, even by cold water.

Utility of Common Salt as Applied to Agriculture.—M. Peligot.—This lengthy paper is chiefly written with the view of criticising a paper published some time ago by M. Velter, "On the Utility of Common Salt to Agriculture, in consequence of its Ulterior Transformation into Carbonate, and, lastly, Nitrate of Soda." The chief result of M. Peligot's researches is, that when common salt naturally occurs in an arable soil, some plants assimilate this salt, but the greater number leave it unassimilated.

Milk met with in Algeria.—M. Commaille.—This paper contains the results of a series of analyses of milk from cows, goats, and sheep, taken at different periods after the birth of the young of these animals, while care is taken to ascertain the various races these different beasts belong to. Goat's milk, general average—Butter, 45·25; caseine, 35·34; lactine, 49·32; lactalbumine, 8·27; lacto-proteine, 1·90; ash, 7·77. Sheep's milk—Butter, 53·75; caseine, 41·85; lactine, 44·94; lactalbumine, 11·30; lacto-proteine, 3·16; organic acids, 4·63; ash, 9·22. The chief result the author points out is, that the milk in Algeria is better, that is to say, richer, especially in nitrogenised compounds, than the milk met with in Normandy and the Elsas.

On a Milk Mushroom (Champignon).—M. Hesling.—The author points out that, even long before milk becomes sour, there are generated in it very small organised spores of an *ascophora* species.

Annalen der Physik und Chemie, von Poggendorff, No. 8, 1869.

This number contains the following original papers and memoirs:—

Researches on the Impact of a Jet of Water.—Dr. Buff.—This is a very lengthy physico-mechanical essay, not bearing in any way upon chemical science. The makers of fire engines will find much interesting matter in this paper.

Limits of Magnetisation of Iron and Steel.—Dr. von Waltenhofen.—A monograph on this subject, the contents of which are entirely of a mathematico-physical nature.

Some Double (Tisin) Crystals of Sulphuret of Iron (Iron Pyrites).—Dr. Hessel.—This is a purely crystallographical essay on the subject, illustrated by a series of engravings.

Regular Cavities which Naturally Occur, or may be Artificially Produced on the Planes of the Crystals of Quartz.—Dr. J. Hirschwald.—Also a purely crystallographical essay, illustrated by several engravings.

Researches made for the Purpose of Determining the Electromotoric Force between Water and some Metals, by means of the Galvanic Compensation.—Dr. E. Gerland.—A mathematico-physical essay.

Meaning of Insulators in the Theory of Electricity.—M. Schwedoff.—This is the continuation of a lengthy monograph on this subject commenced two volumes previously; it is entirely a mathematico-physical essay.

Transversal Magnetismus of Iron and Steel.—Dr. E. Villari.—A very lengthy monograph, very concisely written, and purely mathematico-physical in its contents.

Researches on the Behaviour of Vapours towards the Law of Marriotte.—Dr. Herwig.—The second part of an extensive monograph on this subject, too lengthy and too abstrusely written to be fit for abstraction.

Meteorite of Krahenberg, near Zweibrucken.—M. E. Weiss.—This paper does not contain anything new on this subject, of which we gave an abstract of a paper taken from a previous number of this periodical (Chemical News, vol. xx., p. 83, *Am. Repr. Oct.* '69, page 244).

Observations of Solar Protuberances.—M. Zöllner.—We regret that we cannot extract this paper, as it is copiously illustrated with ten very beautifully executed coloured engravings, which are absolutely required for the proper understanding of the subject.

Evolution of Heat Caused by the Emission of Sound from Solid Bodies.—M. E. Warburg.—A purely physical essay.

American Journal of Pharmacy, September, 1869.

We learn from this number of the death of Prof. H. E. Dussauce, which took place at New Lebanon, Columbia County, N.Y., on the 20th of June last. The deceased, who was born on the 25th of December, 1829, at Paris, was a pupil of Chevreul, and was for a time one of the Professors of Industrial Chemistry in the Ecole Polytechnique. The deceased occupied the position of chemist in Tilden and Co.'s Laboratory, and was one of the editors of the *Journal of Applied Chemistry*, and the editor of several other works. The deceased was well known in Europe as an eminent technologist and an excellent analyst.

This number contains the following original papers and communications on subjects of scientific interest for chemists. We omit some papers relating to the practice of pharmacy, of which it should be said, however, that they highly deserve the attention of those concerned:—

Critical Note on Permanganate of Potassa as a Test for Distinguishing Chlorine, Bromine, and Iodine.—Mr. G. Macdonald.—The author has investigated this subject carefully, and made a series of experiments, the main results of which are, that this method of distinguishing, by means of the reaction produced by permanganate of potassa, between the three haloids above named, is only applicable to very dilute solutions, and, even then, care must be taken that the permanganate of potassa is also in very dilute solution, and added drop by drop, as any excess beyond what the iodide or bromide would decompose would be apt to give the liquid its own characteristic tint. Moreover, the method is applicable to simple solutions of haloid salts, and its use implies some previous knowledge by the operator, both of the composition and the strength of the solution under examination. In a compound solution of a chloride and iodide, this test, *per se*, would be of but little use, as only the presence of the iodide would be indicated, and recourse to other methods would be necessary for the detection of the chloride. In a solution containing no haloid whatever, as, for example, a solution of a nitrate or a sulphate, this test would indicate the presence of a chloride—that is, no change would be produced on the addition of the permanganate. In a solution containing organic matter, the test would, in many instances, be rendered worthless, since the permanganate is readily decomposed by such substances, with changes very similar to those produced by the action of iodides or bromides.

Sulphur in Louisiana.—The Louisiana Petroleum Company, while boring for oil near Lake Charles, reached, at a depth of 442 ft., strata of crystallised sulphur, some 2 ft. thick, and of very pure quality. On boring farther downwards, the auger passed, for a distance of 90 ft, through limestone rock, which yielded about 50 per cent of sulphur, with occasional strata of 6 to 8 feet in thickness of pure sulphur. The boring has now reached to a depth of 600 ft. The Company intend to begin mining operations for the extraction of sulphur, but the cost of such work cannot fail to be very large; yet it appears that there is so great a demand for sulphur in the States that mining it at this depth will pay.

Zeitschrift für Analytische Chemie, von Dr. C. R. Fresenius, second number for 1869.

This number contains the following original memoirs and papers:—

Preservation (Storing) of Solutions of Protochloride of Tin, Sulphuretted Hydrogen, and the like.—Dr. F. Mohr.—The keeping of large quantities of titrated solutions is what is meant by the author, who advises that such solutions, after having been made in large quantity, should be poured in bottles provided with a tubulure at the bottom, through which a perforated cork, into which a downward-bent glass tube is fitted, and that this tube should be connected with another longer tube, by means of india-rubber fittings, and so arranged as to admit of running fluid into a burette; the neck of the bottle is fitted with a perforated cork, wherein a narrow glass tube is inserted. In order to prevent the action of the air upon the fluid contained in the bottle, a layer of petroleum, 1 centimetre high, is poured on the fluid. Saturated aqueous solution of sulphuretted hydrogen may be preserved in the same manner; but the bottle containing it should be kept in a cool place, and not exposed to direct sunlight.

Analysis of Ferromanganese.—M. Darmstadt.—Ferromanganese is a peculiar variety of iron which contains a large quantity of manganese. The general plan of analysis followed in this instance by the author is the same as that published in Fresenius's last edition of "Qualitative Analysis;" the estimation of the carbon was made by Berzelius's method, dissolving the iron in neutral chloride of copper. The result of the analysis quoted, percentically, is:—Iron, 73·474; manganese, 21·064; cobalt, 0·007; zinc, 0·062; copper, 0·072; lead, 0·011: aluminium, a trace; titanium, 0·011; calcium, 0·175; magnesium, 0·035; arsenicum, 0·001; antimony and tin, 0·030; phosphorus, 0·109; sulphur, a trace; silicium, 0·059; carbon, 4·805.

Separation of Oxide of Uranium from Phosphoric Acid.—M. Reichardt.—The author refers to the separation of phosphoric acid from oxide of uranium where the latter is used in large quantity for the estimation of phosphoric acid. Dissolve the phosphate of uranium in hydrochloric or nitric acids, apply heat, add excess of chloride of iron, and, next, excess of solution of carbonate of soda; wherein, aided especially by the large quantity of carbonic acid which is thus set free, the oxide of uranium is readily dissolved, while the phosphoric acid is combined with the oxide of iron. The solution of oxide of uranium in carbonate of soda is acidified with hydrochloric acid, boiled to expel carbonic acid, and the oxide of uranium next precipitated with ammonia.

Estimation of Organic Matter and Nitric Acid in Well Waters.—M. Reichardt.—This paper is chiefly a review, criticising the value and reliability of a number of methods for the quantitative estimation of organic matter and nitric acid in potable water. From this paper we accidentally learn that the water of the well of the house, No. 42, Gerichtstrasse, Berlin, contains, in 1 litre, 0·675 grm. NO_5. The average of twenty-seven different samples of well-water of Leipzig is 0·346 grm. to the litre. The water of the waterworks of Leipzig contains 11·5 parts of NO_5 in 1,000,000 parts of water.

Modification of the Piknometer.—Dr. Gintl.—Since, without the woodcuts annexed to this paper, its contents could not be clearly understood, we only quote the title.

Estimation of Phosphoric Acid in the shape of Pyrophosphate of Magnesia.—Dr. Kubell.—This paper is a concisely written treatise, divided into two sections—the first of which treats of the solubility of the ammonaical phosphate of magnesia in water containing ammonia; the other section treats of the precipitate caused, in an ammoniacal solution containing phosphoric acid, by excess of solution of magnesia. This treatise does not admit of suitable and useful condensation.

Changes Albuminates Suffer when they are Submitted to the Action of Water.—Dr. W. Schmidt.—Albumen, prepared from serum of blood, casein, fibrin, and other similar materials, were submitted, in sealed tubes, to the joint action of a high temperature, ranging from 135° to 150°, and water, in order to test the correctness of M. Meissner's statement that these materials yield, when so treated, peptones. This, however, is not the result of the author's researches, which have not brought to light any other results than those generally known on this subject.

Improvement of the Volumetrical Estimation of Copper and Zinc contained in Ores by means of a Standard Solution of Ferrocyanide of Potassium.—M. Galetti.—This paper is reserved for full translation.

Description of an Improved Apparatus for the Evolution of Sulphuretted Hydrogen.—Dr. Seelhorst.—Without the engravings annexed to this paper it cannot be well understood.

Peculiar Appearance Shown by the Flame of Burning Hydrogen.—Dr. Seelhorst.—The author has repeated Barett's well-known experiments of holding in the flame of burning hydrogen gas very well cleaned glass rods, metals recently cleaned by filing them just previous to the holding in the flame, and has observed the same blue colouration as M. Barett did. But the author is not at all inclined to ascribe this colouration to the effect of burning sulphur, which should be so generally spread about in the shape of some sulphate, as to produce this colouration. The author, though abstaining from stating any precise cause at all, inclines to the belief that the cooling effect of the cold body held in the flame has something to do with this phenomenon. Perfectly pure hydrogen, burning from a platinum burner, as well as from iron or glass burners, exhibited the phenomenon, when cold bodies, just after having been cleaned by scraping or filing, were held in that flame. These experiments were conducted in a laboratory, repeated in a lecture-hall, and in the tap-room of a *café* with the same result.

Estimation of Lime and its Separation from Magnesia when Dolomites are to be Analysed.—Dr. A. Cossa.—The author's object has been to determine what the accuracy is of estimating lime as quicklime or caustic lime, instead of weighing it as carbonate of lime. The experiments were made—(1) With pure oxalate of lime previously dried at 100°; (2) with carbonate of lime precipitated from a solution of pure chloride of calcium by means of pure carbonate of soda; (3) with pure, native carbonate of lime, Iceland spar. The result of an average of three experiments with No. 1 is 0·07 per cent too low; with No. 2, 0·35 per cent too low; with No. 3, 0·27 per cent too high. As regards the analysis of dolomite, the author states that, when care is not taken to re-dissolve the precipitate of oxalate of lime first obtained and re-precipitate this a second time, it is always so contaminated with oxalate of magnesia or ammonio-oxalate of magnesia, that the quantity of lime found as carbonate may be 0·62 per cent in excess of what it ought to be, while the loss for carbonate of magnesia may even be as high as 0·78 per cent.

Analysis of Soft Lead.—Dr. Fresenius.—This paper or treatise is an exhaustive monograph on the analysis of refined lead and the estimation therein by volumetrical methods of iron, copper, zinc, antimony, and other metals. This treatise, as may be expected from the eminent author, is as complete as can be desired, but it is too lengthy and too concisely written for useful abstraction.

Comparative Researches on the Estimation of Phosphoric Acid.—M. Kissel.—The author treats on the gravimetrical and volumetrical methods in use for the estimation of this acid. (*a*) Direct estimation as pyrophosphate of magnesia; average result of three carefully conducted experiments, 99·53 per cent; result by the same method, but with the correction required for the solubility of the ammonio-phosphate of magnesia in ammoniacal water, average of three experiments, 100·22 per cent. (*b*) Indirect estimation as pyrophosphate, following a previous precipitation as molybdophosphate of ammonia; average result, without correction for solubility of ammonio-phosphate of magnesia, 99·09 per cent, with that correction, 99·79 per cent; estimation (gravimetrical) as phosphate of oxide of uranium; average result, 100·33 per cent; estimation as basic phosphate of iron; average result, 99·68. Volumetrical methods: Average result of four experiments with acetate of oxide of uranium, 100·12 per cent. The author has purposely made a series of experiments in order to ascertain the influence of repeated solution and re-precipitation of the ammonio-phosphate of magnesia, obtained in quantitative research, also the influence of excess of ammoniacal salts and the action of dilute ammonia upon pure ammonio-phosphate of magnesia, the results obtained do not materially differ from what is generally known on this subject and published thereon in works on analytical chemistry.

Application of the Principle of Areometry to Quantitative Chemical Analysis.—Dr. Gintl.—The plan devised by the author is extremely ingenious, and deserves the attention of analysts; but we cannot condense his paper or make the principle even understood without the reproduction of some engravings absolutely necessary for the explanation of the subject.

Detection of Bitter Substances other than Hops in Beer.—M. L. Enders.—In order to separate lupuline from quassiïne, absynthiïne and menyanthine, the author proceeds as follows:—Alcohol is applied to separate gum, a mixture of strong alcohol and ether to separate sugar from beer; the solution of bitter substances is next treated with acetate of lead; a precipitate ensues which contains lupuline and hop-resin; treat precipitate with H_2S, separate PbS, wash with alcohol, evaporate the filtrates to dryness, exhaust the residue with chloroform, and repeat this operation, adding a large quantity of warm water; evaporate chloroform when the hop-resin is left as an insoluble matter in the water, which, after separation of this resin, is also evaporated to dryness; the residue has a bitter taste; exhibits when dissolved in water, an acid reaction to test paper; is soluble in alcohol, ether, and chloroform; the weak alcoholic solution is precipitable by acetate of lead, bnt not by tannic acid; does not give, when treated with ammoniacal silver-solution, a deposit of metallic silver. These characters indicate lupuline. The filtrate from the solution above alluded to is freed by means of H_2S from excess of lead, the sulphide of that metal removed by filtration, the filter washed with hot water, and the filtrate heated in order to expel sulphuretted hydrogen gas; and next, a solution of tannic acid is added; in case a precipitate ensues, it is collected on a filter, some pure carbonate of lead is added to the precipitate while yet wet, and the mass is dried, next boiled with alcohol, the filtrate therefrom evaporated to dryness and exhausted with pure ether. This ethereal solution is evaporated to dryness, the residue is either soluble in alcohol, or in a large quantity of hot water, the aqueous solution is precipitable by means of tannic acid, not by acetate of lead; the precipitate is first mixed with concentrated sulphuric acid, and, on addition of some water, yields a bluish violet colour. The substance boiled with ammoniacal solution of silver yields a metallic mirror: these characteristics indicate absynthiïne. The residue insoluble in ether is soluble in alcohol; this solution, after having been diluted with water, is precipitable by tannic acid, not by acetate of lead; the substance on being heated with ammoniacal solution of silver yields a metallic mirror, indicating menyanthine; absence of metallic mirror indicates quassiïne.

Cosmos, September 4, 1869.

Origin of the Alkaline Chlorides found in the Water and Rocks of the Coal-Formation of Luijk, Liege (Belgium).—M. Malherbe.—After referring to the doubts existing about the question whether the plants which have given rise to the coal-fields have been submerged by fresh or salt water, or by a mixture of both, the author contends that, as far as the coal-basin above named is concerned, his opinion is that the plants which served to form the coal were submerged in a mixture of fresh and salt water, since not only the water pumped up from the pits in the locality mentioned contains a large proportion of alkaline chlorides, but the rocks in that part of the country also contain a considerable quantity of these salts. The author's opinion is not shared by the well-known eminent Belgian geologist, M. Omalius d'Halloy, who states that coal has been formed in a similar manner as peat is at the present day, in stagnant fresh water; but the presence of the alkaline chlorides is accounted for, by later irruptions of the sea, and by the many commotions the coal formations have been subject to long after they were formed.

Revue Hebdomadaire de Chemie, September 2, 1869.

This number contains an excellent description of—

The Freezing Apparatus Invented by M. Toselli.—The author applies freezing mixtures made up without the addition of acids, and chiefly prefers the following salts:—Nitrate of ammonia, carbonate of soda, sal-ammoniac, and chloride of potassium, mixed in certain quantities together. The mixture best adapted for his apparatus is made up of equal parts of nitrate of ammonia, carbonate of soda, and water, wherewith a lowering of temperature of —33° can be obtained. Without the reproduction of the woodcuts annexed to this paper, it would be useless to try to describe the apparatus applied by the author, who conducts, at Paris, a business on a large scale, for the artificial production of ice, and the sale and making of his apparatus and the salts used for the production of cold. According to all accounts, his invention is the best and most applicable of the kind hitherto made.

Les Mondes, September 9, 1869.

The Deepest Artesian Well in the World.—If the American reporter of this periodical is well informed there exists at Saint Louis, U.S., an artesian well, which, as far back as the year 1854, had been bored to a depth of 2199 feet, without reaching water bearing strata. In 1865, the previously suspended borings were resumed, and are yet pushed forward; but though a depth of 2852 feet has been reached, no water bearing strata has been found. The borings now proceed only about three inches depth every day, in compact solid granite, and the cost per month amounts to 1600 dollars.

Comptes Rendus des Séances de l'Académie des Sciences, September 27, 1869.

This number, an unusually thin one, opens with a brief but very touching speech of M. Dumas, announcing the demise of the late Master of the British Mint, who was a corresponding member of this institution. The eminent speaker dwelt for a few moments on the great scientific merits of the de-

ceased, pointing out his discoveries and researches, and expressing regret at the loss of such an eminently distinguished *savant*.

The following are the original papers and memoirs relating to chemistry contained in this number:

Action of Permanganate of Potassa upon Asparagine.—M. Campani.—Asparagine is converted, by the action of water alone, into aspartate of ammonia. According to this author, asparagine is converted, by the oxidising action of permanganate of potassa, into ammonia, oxalic acid, carbonic acid, and a trace of hydrocyanic acid.

The Vacuum as a means of Preventing Explosion in Coal-Pits.—M Raffard proposes that, on Saturday evenings, all the shafts of a coal-pit, one only excepted, shall be hermetically closed, and that that shaft shall be put into communication with an air pump, which, on withdrawing the air, will cause the marsh gas, fire-damp, freely to issue from the pores of the coals, and thereby cause a thorough cleansing of the air of the pit. It is very difficult to imagine that such a proceeding will have any really useful effect.

New Hygrometer.— M. Crestin.—The author proposes to place, on the plate of an areometer, a quantity of perfectly dry common salt; the areometer is then placed in pure water, which is covered by a layer of oil. While the salt absorbs moisture, the areometer gradually sinking into the water indicates the degree thereof.

Chinese Industry.—M. Champion.—The author has published a work on the ancient and modern industries of the Chinese Empire. This work is highly spoken of by M. Dumas, who points out that the Chinese excel Europeans in many matters.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 13, 1869.

From the proceedings of the meeting of this Society, held under the presidency of Dr. A. W. Hofmann, on the 12th of July last, and recorded in this number, we find, among the foreign gentlemen elected members of this Society, the names of Prof. Abel, of Woolwich; Dr. E. H. Kinson, Sandhurst, Farnborough; and Dr. W. Odling. The following papers and communications were read:—

Constitution of Tourmalin.—M. C. Rammelsberg.—In the introduction to this essay, the author points out the difficulties which beset this subject, which has frequently been worked at by various mineralogical chemists; but notwithstanding the author himself made a large number of analyses of this mineral, several points of interest were not clearly elucidated, among these—(1) The behaviour of tourmalin on ignition; (2) the degree of oxidation of iron, forasmuch as this metal occurs in this mineral, which is not the case with all varieties thereof; (3) the precise quantity of boron contained in tourmalin. Tourmalin is a very complex mineral; it contains the following elements:—H, K, Na, Li, Fl, Mg, Ca, Mn, Fe, O, Si, B, and Al. Tourmalines are found not containing Li, Fe, Mn, or Ca. The colourless, or pale red-coloured tourmalin, from Elba, contains 0·2 per cent of MgO; a brown variety, from Windischkappel, contains 11·8 per cent MgO; the black tourmalin, from Andreasberg, contains 17·4 per cent FeO. Magnesia tourmalines are yellow or brown-coloured; the magnesia-iron tourmalines are dark brown or black-coloured; iron tourmalines are quite black-coloured; and the tourmalines which do not contain any iron at all; but manganese, are rose or pink-coloured, or sometimes even colourless. As regards the fundamental composition of this mineral, it is a tri-silicate—

$$\overset{I}{R_6}SiO_6—\overset{II}{R_2}SiO_6—\overset{VI}{R}SiO_6.$$

The author proceeds at length, enumerating the various species of this mineral, according to the prevalence therein of certain elements; but, strictly speaking, this portion of his paper rather belongs to mineralogy, and our space, moreover, forbids us to quote the large number of formulæ required to elucidate this subject.

On Chloral.—MM. Martius and Mendelssohn-Bartholdy.—The authors state that they have been induced to try whether it would not be possible to prepare chloral in large quantities, so that if this substance should become used in pharmacy, it could be obtained in a pure state. The hydrate of chloral would, according to the authors, answer this purpose by far the best. This hydrate ought to be a white crystalline mass, endowed with considerable hardness; it should dissolve readily in water, and be devoid of any smell of chloride of carbon or hydrochloric acid, while it should exhibit its peculiarly strong smell. The authors exhibited at this meeting several pounds' weight of chloral, and stated that they hope shortly to be able to exhibit to the members of this Society the synthesis of chloroform by an easily executed method, as also trichloracetic acid, made according to M. Liebreich's method.

On Euxanthon.—M. A. Baeyer.—According to the researches of the late Prof. Gerhardt, the euxanthon, obtained by M. Erdmann from the euxanthinic acid contained in Purrhee, should be composed according to the formula $C_{10}H_6O_3$. The author found that, when vapours of euxanthon are passed over powder of zinc heated in a combustion tube, there is formed a semi-solid hydrocarbon, resembling diphenol; and he concludes, hence, that euxanthon is not a derivative from naphthaline, but has to be referred to a benzole containing four atoms of carbon in a peculiar form. The author, on treating euxanthon with bichromate of potassa and sulphuric acid, did not succeed in obtaining products of oxidation of euxanthon, since the reaction became too violent; but, on fusing euxanthon with caustic potassa, a new substance was obtained, which the author calls euxanthonic acid, $C_{13}H_{10}O_5$. It is a weak acid, which yields, with basic acetate of lead, a reddish yellow-coloured precipitate; with chloride of iron, it yields a red colouration; euxanthon, on the contrary, yields, with that reagent, a green colouration. Euxanthonic acid is far more readily soluble in water than euxanthon.

Synthesis of Picolin.—M. Baeyer.—When acrolein-ammonia is submitted to distillation, an aqueous ammoniacal fluid and a basic oil are obtained. M. Claus discovered that the double salt of platinum of that base possesses the same composition as the picolin platinum salt, $NC_6H_8Cl.PtCl_2$; but the properties of that salt do not at all remind one of picolin. The author of this paper found that the aqueous ammoniacal fluid, which has not been investigated by M. Claus, contains a large quantity of picolin, and this picolin exhibits the very identical properties possessed by the picolin obtained from coal-tar and bone distiller's tar. The author explains the origin of picolin in the following manner:—Fatty substances yield acrolein, and, under the joint influences of ammonia and a high temperature, picolin is formed, according to the following formula:—

$$2C_3H_4O + NH_3 = NC_6H_7 + 2H_2O.$$

Derivatives from Naphthaline.—MM. Darmstädter and Wichelhaus.—The authors continue in this paper the communication of the results of their experiments on this subject, and describe, at great length, how they succeeded, by a very complex process, in obtaining bicyanaphthaline—

$$C_{10}H_6\begin{cases}CN\\CN\end{cases}$$

This substance exhibits needle-shaped pale yellow crystals, difficultly soluble in alcohol and ether, insoluble in water, and fusing at 204°. From this substance, the authors have prepared a compound which they call bicarbonaphthalinic acid—

$$C_{10}H_6\begin{cases}CO.OH\\CO.OH\end{cases}$$

This substance is a solid crystalline material, very difficultly soluble in boiling water, soluble in alcohol, not fusible nor

decomposed at 240°. The authors refer, in this paper, to three varieties of bicyanaphthaline, in addition to the substance of that name already alluded to, and each obtained from a different naphthaline compound.

Action of Fusing Hydrate of Potassa upon Stearolic Acid.—M. S. Marasse.—The author, after referring to the labours of Messrs. Frankland, Duppa, Overbeck, and others, on this subject, states that stearolic acid is not a substituted acrylen, but that the molecule of this acid contains twice the group C=C. Acting upon this idea, the author has succeeded in so managing the action of the fusion with hydrate of potassa as to obtain from stearolic acid a homologue of acrylic acid. The new acid thus obtained is a colourless fatty matter fusing at 21°; its formula is $C_{16}H_{30}O_2$.

Constitution of Benzol.—M. A. Kekulé.—Unless we reproduce the woodcuts annexed to this paper, and essential to its proper elucidation, we cannot usefully give an abstract of it.

Crotonaldehyde.—M. A. Kekulé.—This paper contains the results of a series of experiments, made with the view to prove, experimentally, the mode of the combination of the atoms of carbon in benzole. The paper is too lengthy, and so crowded with formulæ, that it is impossible to give a proper abstract of it.

Lecture Experiments.—M. Kessler.—No. 1. Ignition of a mixture of H and Cl by means of the flame of CS_2 burning in NO, is rather awkward to manage. The author uses the magnesium light for that purpose. After having fastened a bottle filled with H and Cl to a retort stand, a piece of magnesium ribbon is taken hold of with a pair of forceps, ignited in the flame of a spirit-lamp, and moved, close to the bottle, up and downwards. A slight shock indicates the end of the reaction. The bottle is next opened under water.—No. 2. When burning magnesium wire is placed in a vessel containing CO_2, the latter is decomposed, and carbon deposited. Some HNO_3 should be poured into the vessel at the end of the reaction, in order to dissolve some magnesia resulting from the combustion, and to make the deposit of C distinct. —No. 3. Water having been poured into a rather wide-mouthed flask, it is made to boil as briskly as possible. When, after this boiling has been continued for some time, previously-ignited magnesium wire is held deep down in the mouth of the flask, it continues to burn. The same metal burns with great brilliancy in N_2O and NO, also in H_2S and SO_2, but is extinguished by CO. The floating of soap bubbles upon CO_2 is exhibited with the least expenditure of that gas, when it is made to pass through the narrow neck of a large glass funnel.

On Diazocyanbenzol.—M. P. Griess.—This paper contains a first instalment of the results obtained when experimenting on the products of decomposition of diazocyanbenzol. Among these, the author found diazocyanbenzolimid —

$$\left.\begin{matrix}[C_6H_3(CN)N_2]'' \\ H\end{matrix}\right\} N + 3NHBr.$$

This substance is a solid body, almost insoluble in water; readily soluble in warm alcohol; crystallizing, from the solution in that fluid, in large needle-shaped, bright yellow-coloured crystals: fusing at 57°, and exploding when more strongly heated. Iodinecyanbenzol, also a solid substance, insoluble in water, readily soluble in alcohol and ether, and fusing at 41°.

Some Derivatives from Anethol.—M. Ladenburg. —After referring to his former researches on this subject, the author states that he has succeeded in obtaining anol, a solid substance, fusing at 92·5°; soluble in alcohol, ether, and chloroform; and boiling at 250°. Formula, $C_9H_{10}O$. Chloranethol is a somewhat yellowish-coloured fluid which solidifies at a low temperature, and becomes fluid at —6°; boils at 257°; sp. gr., 1·1154. When this body is treated with caustic potassa, and heat applied, there is formed a substance, $C_{10}H_{10}O$; it is a liquid insoluble in water, and boiling at about 242°.

Chrysophanic Acid.—M. Rochleder.—When this acid is distilled along with powdered zinc, anthracen is formed. After this statement, the author proceeds to discuss the formula which chrysophanic acid ought to have, and, having found that chrysophanic acid, dried at 100° (all analyses made of this substance have been made with quantities thereof which were dried at that temperature), retains water, which can only be expelled at 115°, aided by a current of dry carbonic acid gas. The author ascribes to this circumstance the discrepance of the results of the elementary analyses made of this substance, and suggests that the formula of the acid dried at 100° should be written $4(C_{14}H_{10}O_4)+OH_2$. The author also found that chrysophanic acid made from rhubarb root is always contaminated with emodin; but this substance being soluble in a hot solution of carbonate of soda, wherein chrysophanic acid is insoluble, the two may be separated from each other in that manner. Emodin may be precipitated by acids from its alkaline solution, and, after having been carefully washed with water, may be dissolved in alcohol 80 per cent, and obtained in crystals on evaporation of that solution. Emodin exhibits an orange-yellow colour. The chrysophanic acid which has been separated, as described, from emodin, should first be well washed with water, and next repeatedly treated with boiling alcohol of 90 per cent, and thus obtained in pure state. So purified, the formula for dried chrysophanic acid is $C_{14}H_{10}O_4$.

On Naphthaline Red.—Dr. A. W. Hofmann.—At the Paris Exhibition of 1867, there was only one naphthaline color exhibited, to wit, the naphthaline yellow (dinitronaphthol) discovered by Dr. Martius. The author says that he has received, from his friend M. Scheurer-Kestner, a quantity of a very remarkable substance, now known as napthaline red on the continent, and in England designated Magdala red. This substance, as sent to Dr. Hofmann, exhibits a blackish brown, somewhat crystalline, powder, soluble in alcohol, yielding a deeply red-coloured solution, on evaporation of which greenish crystals endowed with metallic lustre are obtained; these crystals proved to be the chloride of a base which, on analysis, was found to be composed of $C_{30}H_{21}N_3$. The eminent author proposes to investigate this subject more fully, for which reason the brief account here given may suffice for the present, the more so as the manufacture of this napthaline red (first made at Bäsle, on the large scale) is as yet rather uncertain.

On Xylidine Red.—Dr. A. W. Hofmann.—When pure xylidine is treated with oxidizing agents, no red-coloured pigment is obtained; neither is this the case when, after having been mixed with toluidine, xylidine is treated as is done for the preparation of rosaniline; but when xylidine is mixed with aniline, and then treated with the agents used to make rosaniline, almost beautiful carmine red pigment is obtained which dyes wool and silk a very fine colour. The probable composition of this pigment is $C_{22}H_{23}N_5,H_2O$.

Contribution to our Knowledge of Chrysaniline.—A. W. Hofmann.—When a solution of pure chrysaniline in pure wood-spirit (methyl-alcohol) is mixed with iodide of methyl, and heated in a sealed tube, for about six hours, to 100°, a solid crystalline substance is obtained, which, after having been purified, may be dissolved in boiling water, from which solution beautifully orange-carmine red crystals are deposited, which constitute the diiodhydrate of trimethylchrysaniline, $C_{20}H_{14}(CH_3)_3N_3,2HI$; the solution of this salt dyes wool and silk a deep orange-yellow, verging upon scarlet-red. From this substance, on being treated, when in solution, with ammonia, the monoiodhydrate of trimethylchrysaniline is obtained—

$$C_{20}H_{14}(CH_3)_3N_3,HI.$$

Trimethyl-chrysaniline yields, with acids, very well-defined salts, which are rather readily soluble in water, excepting the nitrate and picrate. Chrysaniline behaves with iodide of ethyl as it does with iodide of methyl.

Porphyritic Rocks of Austria.—M. G. Tschermak.—The Vienna correspondent of this Society, M. Ludwig, writes to the effect that the author named at the heading of this paragraph has made a series of researches on augite and amphibole. The former mineral, if crystallised, is a combination of $MgCaSi_2O_4$ and the therewith isomorphous $FeCaSi_2O_4$. Augite, which is imbedded in rocks, contains alumina, and, moreover, a silicate made up according to the formula, $MgAl_2SiO_4$. The composition of amphibole is rather more complex, because it also contains a soda silicate.

On Benzylic Acid.—M. A. Jena.—When benzile is heated with an alcoholic solution of caustic potassa, benzylic acid is formed, and also benzoic acid. Benzylic acid is formed more readily when benzile is heated with water in sealed tubes. Pure benzylic acid fuses at 150°; moistened with concentrated sulphuric, it becomes red-coloured; heated for some length of time to 180°, it yields a red-coloured resin, and a compound, $C_{28}H_{22}O_5$. When benzylic acid is treated with dilute sulphuric acid and bichromate of potassa, water, carbonic acid, and benzophenon are formed—

$$\underbrace{C_{14}H_{12}O_3}_{\text{Benzylic acid.}} + O = H_2O + CO_2 + C_{13}H_{10}O.$$

Formation of Adipinic Acid from Mucic Acid.—M. L. Marquardt.—The author says—"Some time ago M. Bode succeeded in obtaining from the compound $C_6H_4Cl_2O_4$ (which compound is the result of the action of excess of phosphor-chloride upon mucic acid), by means of zinc or sodium amalgam, a substance which he (M. Bode) called muconic acid, $C_6H_6O_4$; this acid only differs from adipinic acid by a deficiency of 2H. The author of this paper states that he has obtained, from muconic acid, pure adipinic acid, by treating the former, after having been moistened with water, with sodium-amalgam, and leaving this mixture standing for some hours in a warm place. The fluid, after having been removed from the mercury, is acidified with dilute SO_3, next shaken up with ether, and, on removal of that fluid, by distillation, adipinic acid remains behind.

Annalen der Chemie und Pharmacie, September, 1869.

This number opens wih a series of three treatises on trimethyl-benzol. The first of these papers treats on:—

The Trimethylbenzol which is Formed by the Introduction of an Atom of Methyl into Xylol.—MM. R. Fittig and K. Laubinger.—In the introduction to this paper, the authors state that mesitylen is a peculiarly-modified trimethyl-benzol; and that the substance which, under the name of cumol, or pseudo-cumol, has been met with in coal-tar is also a modification of trimethyl-benzol, but different from mesitylen by its monobromide, $C_9H_{11}Br$, which is a crystalline substance, fusing at 73°. Pseudo-cumol has often been the subject of chemical researches; but the authors of this paper deny any value to these researches, since, according to them, pseudo-cumol, as applied to these researches and obtained from coal-tar, is and always remains, any rectifications and fractional distillations notwithstanding, a mixture of several hydrocarbons. The authors, therefore, have prepared pseudo-cumol synthetically, by introducing into xylol 1 atom of methyl. The fluid thus obtained was purified by distillation with sodium, and was found to boil constantly at 166°. *Products of substitution of pseudo-cumol.*—Mononitropseudocumol, $C_9H_{11}(NO_2)$, is a solid substance, crystallising in prisms, fusing at 71°, soluble in alcohol. It is distinguished from nitro-mesitylen by its point of fusion, and by its being soluble in cold-fuming nitric acid without thereby undergoing any change. Dinitropseudocumol has not been obtained by the authors in pure state. Trinitropseudocumol, $C_9H_9(NO_2)_3$; also a solid substance fusing at 185°, and crystallising from its solution in benzol in large quadratic-shaped prisms. The authors then treat, under the following heads, the following subjects:—*Products of reduction from trinitropseudocumol; bromated products of substitution from pseudocumol; products of oxidation of psuedocumol.* Among the latter, xylylic acid, $C_9H_{10}O_2$, is found; also paraxylylic acid, and xylydinic acid, $C_8H_9O_4$, which are described at great length, as well as their salts.

The second treatise on this subject is headed—

On the Trimethylbenzol which is Generated when Two Atoms of Methyl are successively introduced into Toluol.—MM. Fittig and Jannasch.—The authors say they have proved, by researches made and published some time ago, that the methyltoluol prepared synthetically from toluol differs from xylol; a difference undoubtedly due to the unequal position of the atoms of methyl towards each other. The authors therefore argue that, if, synthetically, a third atom of methyl be added to the methyltoluol (dimethylbenzol), a trimethylbenzol, different from pseudocumol will be obtained. In order to prove this hypothesis by experiment, they prepared from toluol a large quantity of methyltoluol; and, on treating that with bromine, obtained *monobromated methyltoluol*, $C_6H_3Br(CH_3)_2$, a liquid as clear and colourless as pure water, boiling at about from 204° to 206°. By means of iodide of methyl and sodium, trimethylbenzol was prepared from the liquid just alluded to. The result was the generation of a liquid boiling at 166°, and not differing in physical qualities from pseudocumol. In many of its chemical characters this trimethylbenzol is not distinguished from pseudocumol. The greater part of this paper is devoted to a discussion of the relative position of atoms of CH towards other groups of polymers thereof; but since, without the introduction of some woodcuts annexed to the original, this rather abstruse subject cannot be clearly understood, we proceed to the third treatise:—

On the Trimethylbenzol contained in Coal Tar.—MM. Fittig and Wackenroder.—The authors have prepared from the hydrocarbons of coal-tar (which have a high boiling point), by carefully conducted, often-repeated, fractioned distillation, a hydrocarbon, the boiling point of which lay between 164° and 167°. This material has been converted into a trinitro-compound, which, after having been purified, yielded a solid crystalline body, fusing at 230°, soluble in alcohol, and yielding, after carefully-conducted elementary organic analysis, results leading to the formula $C_9H_9(NO)_{23}$. On dissolving this substance in warm benzol, the authors found that the body alluded to is not a simple compound, since the mother liquor of the solution in benzol yielded, on evaporation (after the previous separation of the crystalline compound just mentioned), a batch of prismatically-shaped crystals, entirely different from the needle-shaped body first obtained, which last crystalline body was found to fuse at 185°, and to possess all the properties of trinitropseudocumol. The researches of the authors, very exhaustively described, lead to the result that the trinitro-compound obtained from the hydrocarbon from coal-tar above alluded to is a mixture of trinitromesitylen and trinitropseudocumol; accordingly the hydrocarbon from coal-tar boiling at from 164° to 167° is a mixture of pseudocumol and mesitylen, which latter substance may even be prevalent in this fluid.

Electrolysis of Water in Contact with Silver.—Dr. Runspaden.—This monograph treats on the fact first observed by Prof. Wöhler—that when water acidified with sulphuric acid is decomposed by a galvanic current, and silver is applied as electrodes, peroxide of silver is deposited on the anode and metallic silver on the cathode. The two main questions answered by the author by a series of experiments are—What is the cause of the formation of peroxide of silver on the positive pole, and by what means does the metallic silver find its way from the positive to the negative pole? The treatise is too lengthy and too concisely abstracted already in this periodical [the treatise was published originally as a separate work] to admit of useful condensation. In an appendix, the author informs us that there is an error

in all works treating on chemistry and physics, viz., the statement that gold (pure, of course) and platinum are the only two metals which are not oxidised at the positive pole when serving as electrodes. The author finds, and has confirmed by experiments carefully conducted, so as to exclude any source of error, that gold itself is oxidised to a very considerable extent, and that, during experiments as those alluded to, there is formed a definite oxide, $Au_2O_3,3H_2O$: percentically—gold, 79·47; oxygen, 9·62; water, 10·91.

On Chlorous Acid.—M. Brandau.—The author gives, in about twenty pages, a very complete and exhaustive treatise on the preparation and properties of chlorous acid, both as gas and as liquid. Since, however, the engravings added to this paper are absolutely required to understand a great part of it, we content ourselves by describing the properties of the liquid chlorous acid. It is a liquefied gas; colour of fluid, deep red-brown; very fluid. Even below 0°, the vapour of this liquid exerts a considerable pressure. Freshly prepared, the fluid boils about half a degree above 0°. If this fluid is suddenly brought to a temperature of about + 8° to 10°, it explodes with great violence. It cannot be kept without continuous and spontaneous decomposition for any length of time. The gas given off from this liquid exhibits the well-known greenish-yellow colour of chlorous acid. The specific gravity of the liquefied gas at 0°, referred to water at 4° (the point of greatest density of water), is 1·3298.

Preparation of Chlorate of Baryta.—M. Brandau.—The author makes a mixture of commercial sulphate of alumina, of sulphuric acid, water, and chlorate of potassa. The mixture should have the consistency of a thin magma, and be heated on a water-bath during half an hour, while it is frequently stirred up. The reaction which takes place is represented by the undermentioned formula:—

$$[Al_2(SO_4)_3] + SH_2O_4 + (ClKaO_3)_2 = [Al_2(SO_4)_3 + SKa_2O_4] + (ClHO_3)_2.$$

The product is a solution of hydrated chloric acid, alum, excess of sulphate of alumina, and excess of sulphuric acid. After the mixture has become quite cold, it is mixed with several times its bulk of alcohol, filtered, and washed with alcohol of 50 per cent. The alcoholic filtrate is neutralised with hydrate of baryta, whereby chlorate of baryta, sulphate of baryta, and some alumina are formed. The bulk of the alcohol is removed by evaporation. The aqueous solution of chlorate of baryta is next filtered, and the residue washed with water (distilled, of course). The liquid is next evaporated to crystallisation, yielding pure chlorate of baryta. A slight excess of sulphate of alumina and sulphuric acid should be applied, since, otherwise, some chlorate of potassa will remain mixed up with the chlorate of baryta.

The Brominated Products of Substitution of Dibenzyl.—Dr. Marquardt.—The author first refers to the researches made on this very same subject by MM. Fittig and Stelling, and then describes a series of identical compounds as those obtained by the parties just named, but prepared in a different manner. Chiefly the effect of a different temperature appears to be in play, in this instance, to produce compounds of different physical properties.

On some Products of Decomposition of Tribenzylamine.—M. W. Rohde.—This paper, being a critical review of M. Limpricht's labours on this subject, is not well suited for abstraction.

Determination of the Equivalent of Albumen.—M. Fuchs.—After briefly reviewing the researches made by Messrs. Schwarzenbach, Lieberkuhn, and others, on this subject, the author describes a series of his own experiments, the main result of which is that the precipitates formed by albuminous substances and platino-cyanide of potassium are substances of variable composition and decomposable by water. The author also found that the silver compound of albumen applied by M. Lieberkuhn for the determination of the albumen does not answer that purpose, since, on repeating, even up to seven times, the last-named author's experiments, he found the results to vary considerably, and, among themselves, to be different from those obtained by M. Lieberkuhn. On repeating M. Commaille's experiments on this subject, the author found that his very carefully-conducted experiments agreed with those of the last named gentleman very closely, and that, therefore, the compound obtained when chloride of platinum and a slightly acidified solution of albumen are mixed is the precipitate best suited for the determination of the equivalent of albumen.

Occurrence of Laurite in the Platinum Ore found in the Oregon Territory, U.S.—Professor Wöhler.—Laurite is a mineral, first met with in the platinum ores found in Borneo, and composed of sulphide of ruthenium and sulphide of osmium. In the platinum ore here alluded to, this mineral is met with in such minute crystals that they are only distinguishable when magnified 50 diameters. Chemical tests, however, distinctly detected the laurite, which has been fully described some years ago by this eminent author.

Zeitschrift für Chemie von Beilstein, No. 15, 1869.

This number contains the following original papers:—

On Orthonitrodichlorophenol and an Isomeric Dichlorophenol.—M. O. Seifart.—Orthonitrodichlorophenol, $C_6H_2Cl_2NO_2OH$, is a solid substance, crystallising, from its ethereal solution, in rhombic-shaped crystals; soluble in ether, alcohol, and chloroform, but not in water; is not capable of being sublimed; fuses at 125°, but becomes decomposed at the same time. The author gives a catalogue of salts which this substance forms:—The ammonium salt, $C_6H_2Cl_2NO_2ONH_4 + HO$, is a crystalline substance, readily soluble in hot water; orthoamidodichlorophenol is a solid substance, soluble in water, but far more readily in alcohol, and fuses at 166°; dichlorphenol, $C_6H_3Cl_2OH$, is a solid substance, difficultly soluble in water, readily soluble in alcohol and ether, fuses at 65°, and boils at 220°.

On Chloronitrophenols.—MM. Faust and Saame.—Chloronitrophenol, $C_6H_4Cl(NO_2)O$, is a solid body, exhibiting bright yellow-coloured, large-sized crystals; it smells like saffron, fuses at 87°, is nearly insoluble in water, but readily soluble in alcohol and ether; it forms salts which crystallise, and are readily soluble in warm water. The authors give a lengthy catalogue (the name and formulæ) of a series of these salts, and distinguish α, β, and otherwise designated compounds, which, however, vary only in slight particulars from each other.

Decomposition of Acetate of Silver by Iodine at a High Temperature.—M. Birnbaum.—When a mixture of acetate of silver and iodine is submitted to heat, there ensues, at a comparatively low temperature, a very strong reaction, the products of which, partly vapours, and partly permanent gases, were, by suitable means, condensed and collected by the author. Among the condensable vapours, he found acetate of methylic ethyl, boiling at 55°, and hydrate of acetic acid. Among the gases, carbonic acid, acetylen, and, beside this, another carburetted hydrogen were found. The solid residue of the reaction consisted of iodide of silver and some carbonaceous matter. The author enters into a very lengthy discussion as to the origin of the different substances found, but we cannot follow him therein, since it would require the reproduction of an enormous series of formulæ. When acetate of silver is heated by itself, a very violent reaction ensues, which sometimes even comes to actual combustion. The reaction yields acetic acid, and, among the gaseous products, CO_2 and marsh gas. The residue in the retort was found to consist of metallic silver and carbon.

Definition of the Place to be Assigned to the Benzol Series.—M. V. von Richter.—A paper not suited for abstraction.

New Method of Formation of Ortho-Chlorobenzoic Acid.—M. Wroblevsky.—When sulpho-diazo-

chlorotoluol is boiled with anhydrous alcohol, there is formed ortho-chlorotoluol, $O.C_6H_4Cl.CH_3$, a fluid boiling at 156°, and which, on being treated with chromic acid, yields ortho-chlorobenzoic acid, a solid substance, difficultly soluble in water, but readily so in alcohol, and fusing at 151°.

Behaviour of Toluidine towards Bromine.—W. Wroblevsky.—When, into an alcoholic solution of toluidine, a mixture of air and vapours of bromine are passed, a large quantity of dibromotoluidine, and only very little monobromotoluidine, is formed; the former precipitates, and is collected on a filter. After addition of water to the alcoholic solution, the filtrate is evaporated, and until after having ceased to give off acid vapours. Ammonia is then added, in order to precipitate monobromotoluidine. Dibromotoluidine—

$$C_6H_2Br_2(NH_2).CH_3,$$

is a solid body, crystalline, fusing at 73°, soluble in alcohol and ether, not in water.

On Ethyl-Phenol.—MM. Beilstein and Kuhlberg.—The authors state, first, that it is just possible that tyrosin may be equal to amido-ethyl-para-oxybenzoic acid, $C_9H_{11}NO_3$, and they tried to obtain it (tyrosin) from ethyl-para-oxybenzoic acid, which latter acid may be made by acting upon ethyl-phenol with sodium and carbonic acid. The researches made by the authors, and described in this paper, are, as might be expected, of a very complex nature, their aim being the synthesis of tyrosin. We regret that the paper is not suited for further abstraction.

Moniteur Scientifique, No. 305, September 1, 1869.

This number contains, as usual, a series of very well written papers, but those which are original do not belong to the domain of chemistry. Among the *brévets d'invention*, we briefly notice that MM. Broenner and Gutzkow have obtained, in France, a patent for the manufacture of anthracen, by distilling the asphalte, employed for making street pavements, with super-heated steam, and a subsequent sublimation of the raw product obtained. The anthracen is converted into anthraquinon, by gently heating the former with twice its weight of nitric acid, sp. gr. 1·3 to 1·5, and washing with water the product obtained. The anthraquinon is converted into alizarine and purpurine (both are formed at the same time), by dissolving it in gently heated sulphuric acid, to which solution nitrate of protoxide of mercury is added. The material resulting from this reaction is dissolved in an alkali, filtered, and next precipitated by an acid, whereby variable quantities of alizarine and purpurine are obtained. This process of manufacture is already carried out, on the large scale, by MM. Meister, Lucius, and Co., at Hoechst, near Frankfort-on-the-Maine, and is a great improvement upon MM. Græbe and Liebermann's method. The editor of the French paper above named states that he received from the manufacturers just named a sample of a ¼ of a kilo. of this artificially-prepared alizarine.

No. 306, September, 15, 1869.

This number contains only the following original communication:—

A Letter from MM. Meister, Lucius and Co., at Hoechst, near Frankfort-on-the-Maine (dated September 10th last), wherein these parties state that they are not manufacturing artificial alizarine by the method for which MM. Broenner and Gutzkow have taken a French patent. They also desire it to be understood that, for some time already, they have manufactured a substance which they call *alizapurine*, by a process kept secret. M. Camille-Kœchlin, of Mulhouse, after having very carefully tested a sample of the substance made by the manufacturers above-named, states:—"The sample sent, though it is not truly an alizarine in the strictest sense, since it differs, in many respects, from genuine alizarine, as obtained from madder, or as that lately produced by artificial means, yields, however, in its application, colours superior to those obtained from madder and any of its commercially made products; and no doubt the material made by MM. Meister and Lucius will be the madder of the future." M. Kœchlin adds—"The paste, for in that state it is obtained, I experimented with has fully five times the tinctorial power of madder, and all the colours are more brilliant.

The other papers contained in this number are not original, and, excepting the *brévets d'inventions*, are already either published by us in full—as, for instance, Mr. Abel's paper on explosive substances—or have been abstracted by us from the original publications in which they appeared.

Revue Hebdomadaire de Chimie, September 9, 1869.

Apparatus for the Liquefaction of Protoxide of Nitrogen and other Gases.—M. Deleuil.—The apparatus, of which an excellent woodcut is given, is an improvement upon the very generally used and well-known apparatus of M. Natterer, of Vienna, and, in principle, the same—viz., a force-pump, to the piston of which an upwards and downwards movement is imparted by means of cranks and wheelwork. The recipient for the condensed gas, and the body of the pump, are surrounded by a strong freezing mixture, and the recipient is provided with properly constructed valves, whereby it is possible to make, with ease and comfort, and without danger, experiments with liquefied gases in a lecture-room; while the apparatus for condensing the gases is placed in a separate room by itself. Without reproducing the cut, we cannot enter into more details on this subject. The price of the apparatus complete is, at Paris, 1900 francs (£76).

Annales de Chimie et de Physique, August, 1869.

This number contains only one original paper, or, rather, a lengthy essay, on—

Interrupted Currents.—M. A. Cazin.—This essay is strictly of a mathematico-physical nature, and not suited for abstraction.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 140, August 15, 1869.

This number does not contain any original paper relating to chemistry or allied sciences.

Comptes Rendus des Séances de l'Académie des Sciences, October 4, 1869.

A great portion of this number is devoted to lengthy discussions upon the manner in which the metrical system has been obtained. Those who have a desire to impugn its accuracy have brought forward several alleged facts relating to inaccuracies committed during the geodesical surveys which preceded the introduction of the *metre*. It is satisfactory, however, to find that these inaccuracies are only imaginary, and the discussions here alluded to fully bring out the important fact, that those who desired to detract from the value of the work of the committee of 1790 are mistaken, even so much so as to confuse works of far later date (1808) with those done in 1789 and 1790.

Artificially-Crystallised Silver Amalgam.—M. E. Dumas.—It appears that at the Mint at Bordeaux (France now keeps up three mint establishments—one at Paris and one at Strasbourg), there has been left standing, in an iron mercury bottle, a quantity of about 10 kilos. of that metal, which had been used to extract the silver out of some refuse residues. On filtering through chamois leather, there were left upon the filter a certain number of well-defined crystals, which, on analysis, were found to contain, in 100 parts:—Silver, 27·4; quicksilver, 72·6; and traces of gold. The native amalgam of these two metals contains in 100 parts, silver, 36, and quicksilver, 64, corresponding with the

formula $AgHg_2$. The crystals above alluded to correspond to the formula $AgHg_3$.

Disappearance of the Acids of the Grape and their Probable Conversion into Sugar.—M. Petit.—The author states that the ripening of grapes is accompanied by the disappearance of a large quantity of acid. Green, unripe grapes yield, on an average, 36 grms. of acid to the litre. When the grapes ripen, they double in bulk, and ought, if only water had been added during the process of ripening, to have yielded 18 grms. of acid to the litre, while only from 5 to 6 grms. is detected by analysis. It should be stated that this result is not due to the saturation of the acid by bases, since the ripe grape contains less base than the unripe grape does.

Constitution of Pseudotoluidine.—M. Rosenstiehl.—The author gives the following *résumé* of his paper on this subject:—"I wish to acknowledge an error formerly made, to point out that the constitution of pseudotoluidine is not yet accurately known and well established." Lastly, the author states that he does not intend to pursue studies on this subject any further. The paper is chiefly a critical review of the labours of others on this subject as compared with those of the author.

Cosmos, October 2, 1869

Manufacturing Manure from Offal of Wool.—M. Pichelin.—Fifty kilos. of this offal are mixed with 33 kilos. of concentrated sulphuric acid and 35 kilos. of nitric acid, sp. gr., 1·321. This mixture is well stirred up for about ten minutes, and next mixed with some native phosphate, coprolites, for instance, in the proportion of 100 kilos. of the acid mixture to 200 kilos. of very finely ground up phosphates. This manure becomes, in forty-eight hours, as hard and dry as rock, so that it has to be ground up again under mill-stones.

Conservation of Wood by Solutions of Salts of Copper.—M. Morin states that he has in his possession wooden water-wheels which have been in use for more than 1500 years for the evacuation of water from a copper mine. These wheels have a diameter of 6 metres; and, on a portion of the wood being analysed by M. Payen, it was found to be perfectly sound, and to be partly converted into a compound of cellulose and copper, precisely similar to that which is formed in Boucherie's process for the preservation of wood by sulphate of copper.

Tanned Cotton, also called cotton-leather, is prepared by treating cotton fabrics in a similar manner to that in which skins and hides are treated for the manufacture of leather. Cotton hereby acquires greater strength, and is more enabled to resist the effects of moisture and disintegrating efforts.

Zeitschrift für Chemie von Beilstein, No. 16, 1869.

We find in this number the following original papers:—

Test for Arsenic and the Preparation of Hydrochloric Acid free from Arsenic.—M. Bettendorff.—When arsenious or arsenic acid is dissolved in fuming hydrochloric acid, and there is added thereto a solution of protochloride of tin dissolved in hydrochloric acid, a brown-coloured very bulky precipitate, which rapidly settles down, is formed, which precipitate, after having been collected on a filter and washed, first with hydrochloric acid, next with water, to remove the latter entirely, constitutes, after having been dried over sulphuric acid *in vacuo*, a greyish coloured powder, of metallic aspect; this, on being rubbed in an agate mortar, exhibits metallic lustre, and is volatile on being heated, while oxide of tin, in the shape of a very light powder, is left. On being analysed, the precipitate was found to consist of from 98·46 to 95·86 per cent of metallic arsenic, according as to its preparation, arsenious acid, arsenic acid, or arseniate of ammonia and magnesia had been applied. The precipitate could never be obtained quite free from tin. The author further states that when the hydrochloric acid employed has a sp. gr. of 1·115, the arsenious or arsenic acids dissolved therein become, if not entirely, at least for the major part, converted into chloride of arsenic; and the reaction described, therefore, takes place between that chloride and protochloride of tin. When the hydrochloric acid has a sp. gr. of 1·100, the arsenious acid is not converted into chloride of arsenic, but is dissolved as arsenious acid; chloride of tin does not act upon combinations of antimony under the same conditions. The author advises that crude hydrochloric acid, sp. gr. 1·164, should, in order to eliminate all arsenic from it, be treated with a strong solution of protochloride of tin in pure HCl, left standing for twenty-four hours, the precipitate removed by filtration, and the acid next placed in a retort, the first 1-10th of the distillate kept separately, and the remainder distilled off to dryness, when that portion will be found absolutely free from arsenic; the first 1-10th might, in some cases, retain 0·02 per cent of that metal.

Orthoxylol, a New Modification of Dimethyl-Benzol.—MM. Bieber and Fittig.—The authors have discovered a new hydrocarbon, C_8H_{10}, which differs from isoxylol and methyl toluol, and has been named by them *orthoxylol*. It is a fluid body, and boils at 141°; it is distinguished from other substances of isomeric composition by the difficulty wherewith it yields nitro-combinations, and, also, by the slow action which a mixture of chromate of potassa and sulphuric acid exerts upon this substance.

On Bromotoluol, Bromotoluol-Sulpho Acid, and Isomeric Sulpho-Hydrate of Toluol.—MM. Hübner and Wallach.—This rather lengthy paper is not at all suited for any useful abstraction with due justice to the labour of the authors.

Action of Sulphurous Acid upon Chloride of Platinum.—M. Birnbaum.—The author reviews, at some length, the labours of other investigators on this subject, and then states that, when ammonio-chloride of platinum is placed in a concentrated aqueous solution of sulphurous acid, and the mixture heated on a water-bath, care being taken to keep excess of sulphurous acid, a yellow solution is obtained; this solution was evaporated to dryness, again some aqueous SO_2 added to it, and dried over SO_3. A compound was obtained in crystalline state, which contained platinum, ammonium, chlorine, and sulphurous acid—Pt: $3Cl : SO_3 : 2NH_4$. When the strongly acid solution of ammonio-chloride of platinum in sulphurous acid was saturated with carbonate of potassa, a salt was obtained wherein the different component bodies were contained in the proportion expressed by Pt: $3Cl : SO_3 : 2NH_4 : K$. This salt is the potassa salt of the acid first obtained by the action of SO_2 upon ammonio-chloride of platinum in combination at the same time with chloride of ammonium. The formula of the acid just alluded to is—

$$Pt\left\{\begin{matrix}Cl\\HSO_3\end{matrix}\right\}+2NH_4Cl.$$

The author succeeded, by means of a complicated set of experiments, in substituting, for both atoms of chlorine of the chloride of platinum, the radical HSO_3, and thus obtained a crystalline compound—

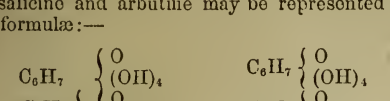
$$Pt\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\}+2NH_4Cl+H_2O.$$

No. 17, 1869.

This number contains the following original papers:—

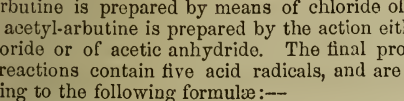
Contribution to our Knowledge of Isomerism in the Benzoic Acid Series.—M. Hübner.—This memoir is a critical review of the labours of M. V. von Richter on the subject above-named; and the author defends his own experiments on this subject, and proves that M. V. von Richter has made several mistakes. The paper is not suited for abstraction.

On Arbutine.—M. A. Schiff.—Just in the same manner as salicine can be split up into glycose and saligenin, arbutine is split up into glucose and hydrochinon. The relation between salicine and arbutine may be represented by the following formulæ:—



Salicine Glycosalicyl-alcohol. Arbutine Glycohydrochinon.

Benzoyl-arbutine is prepared by means of chloride of benzoyl; the acetyl-arbutine is prepared by the action either of acetyl-chloride or of acetic anhydride. The final products of these reactions contain five acid radicals, and are made up according to the following formulæ:—



Pentacetylarbutin. Pentabenzoylarbutin.

These bodies are solid, colourless, insoluble in water, very slightly soluble in ether, and better soluble in hot alcohol; the acid radicals can be removed by boiling with weak bases. The author's paper is full of a series of formulæ similar to those here quoted; he states that an aqueous solution of arbutine reduces freshly precipitated oxide of silver readily at a low temperature, A solution of arbutine yields, with solution of perchloride of iron, a deep blue colouration, which gradually disappears; but the derivatives obtained from arbutine do not do so.

Isomeric Nitrotoluols and Toluidines.—MM. Beilstein and Kuhlberg.—After referring to the experiments made on the subject by M. Rosenstiehl, the authors state that the party just named did not enter into any particulars as regards the splitting up of nitrotoluol into its different components—that is to say, all of them nitrotoluols differing from each other by slightly modified properties, the various bodies being distinguished by the prefixes *α*, *β*, and so on. The paper is rather a catalogue of formulæ, and is divided into five sections, treating of the sulpho-acids; toluidines and para-toluidines; aceto-toluides; toluidine derived from xylol; and *β* chlorotoluol, $C_6H_4Cl.CH_3$. The authors, moreover, state that this paper is intended only as a general survey of the subject, and that they continue their researches thereon.

Isomeric Nitro-Ethyl-Benzol and Xylidine.—MM. Beilstein and Kuhlberg.—*α* nitro-ethyl-benzol boils at 246°, has a specific gravity of 1·124 at 25°, and is a yellow-coloured fluid; *β* nitro-ethyl-benzol is also a liquid, boils at 227°, sp. gr. 1·126 at 24°. The *α* compound is capable of yielding acids; not so the *β* compound. Xylidine, $C_6H_4.C_2H_5.NH_2$, corresponding to the *α* nitro-toluol, boils at 214°, is a limpid liquid, which becomes readily brown-coloured on exposure to air; sp. gr. 0·975. The *β* xylidine boils at 210°. Acetoxylide, $C_8H_9.NH(C_2H_3)O$; the *α* compound boils at 317°, fuses at 94°, and is somewhat soluble in hot water; the *β* compound is readily soluble in hot water, and boils at 305°; both are solid bodies.

On Dichloric and Trichloric Benzoic Acid.—MM. Beilstein and Kuhlberg.

Derivatives of Benzol obtained from Toluol.—MM. Beilstein and Kuhlberg.—These papers are not well suited for abstraction.

On Paratoluidine.—MM. Hübner and Wallach.—Paratoluidine is a liquid which in pure state resists a cold of −21° without becoming solid, is very readily soluble in alcohol and ether, and rather soluble in water; with acids, it yields salts which crystallise. Sulphate of paratoluidine, $(C_6H_4NH_2.CH_3)_2SO_4H_2$, is very readily soluble in water. Acetoparatoluide, $C_6H_4.CH_3.NH.C_2H_3O$, is a solid body exhibiting needle-shaped crystals, fusing at 105°, soluble in alcohol and ether, but not readily soluble in water.

Solubility of Nitrates in Nitric Acid; Separation of the Nitrates of Potassa and Soda from each other.—M. C. Schultz.—Nitric acid does not form acid salts. Several nitrates which are readily soluble in water are difficultly soluble in nitric acid; and this fact explains why silver, lead, and iron are not readily acted upon by very concentrated nitric acid. One part, by weight, of the undermentioned salts require for their solution in—

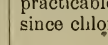
	The First Hydrate of Nitric Acid, HNO_3.		Hydrated Nitric Acid, $2HNO_3 + 3H_2O$.		
			(At 20°.)		(At 123°.)
	Parts.		Parts.		Parts.
KNO_3	1·4	....	3·8	....	1
$NaNo_3$	66·0	....	32·0	....	4
$LiNO_3$.....	200·0	....	—	....	—
$AgNO_3$....	500·0	....	30·0	....	6

The nitrate of baryta, strontia, and lead are as insoluble in both the above-named nitric acids as the sulphates of these metals are in water. The nitrates of potassa, rubidium, and ammonia are readily soluble in hydrated nitric acid. The author is of opinion that by far the greater solubility of nitrate of soda than nitrate of potassa in nitric acid might be applied to the separation of these salts from each other; but the author very properly observes, also, that working with nitric acid, especially on the large scale, is, in many instances, impracticable. For analytical purposes, this plan is not suitable, since chloride of sodium is rather insoluble in nitric acid.

No. 18, 1869.

This number contains the following original communications:—

Researches on the Sulpho-Acids of Benzol.—M. Ross Garrick.—This paper contains an enumeration of the most prominent salts of the three following acids:—From benzolsulpho acid, C_6H_4Br,SO_2HO; isobromobenzolic acid, $C_6H_4BrSO_2HO$; benzoldisulpho acid—



Without reproducing a very lengthy series of formulæ, the chief contents of this paper, we do not find therein anything worth much notice, and therefore abstain from further quotation of its contents.

New Method of Converting Fatty Acids into their Alcohols.—Dr. Saytzeff.—This is simply a preliminary notice, *pour prendre date*, written from Kasan. The author says that, when sodium amalgam is suffered to act upon a mixture of fatty acids and their anhydrous chlorides, the alcohols belonging thereunto are obtained; for instance, acetic acid and acetyl-chloride yield ethylic alcohol. The author promises full and complete details in a future paper.

Formation of Aniline from Bromide of Benzol.—MM. Hübner and Alsberg.—This paper is also marked "preliminary notice." It is written with the object of elucidating the question, Whether the atoms of hydrogen contained in benzol do all occupy the same rank? In order to settle this point, the authors have set to work to obtain, from different bromated and chlorinated benzols, anilines, and to compare these mutually. For this purpose, bromide of benzol was nitrified, with the result that two varieties of bromonitrobenzol were obtained; one of these compounds, evidently, is the same as that described by M. Couper; the other compound is a monobromonitrobenzol, fusing at about 38°, and yielding, on being amidised, two bromoamido compounds. The bromonitrobenzol (Couper's) fuses at 125°, and yields, on being treated with tin and hydrochloric acid, an amido compound, $C_6H_4BrNH_2$; this, on being first treated, while in alcoholic solution, with sodium, and next with chloracetyl,

[English Edition, Vol. XX., No. 516, pages 189, 190.]

yielded an acetanilide, fusing at about 116°, soluble in water, and more readily soluble in alcohol and ether. The authors promise full details on this subject afterwards.

Thihydrobenzoic Acid.—MM. Hübner and Upman.—A short "preliminary notice." When sulphobenzoic chloride is brought into an apparatus wherein hydrogen gas is briskly evolved from tin and HCl, a white substance is separated, which, on being collected on a filter, washed with water, dissolved in ammonia and re-precipitated by HCl, and boiled in alcohol to which HCl is added, there is obtained a solid crystalline substance, a compound which, on being submitted to elementary analysis, was proved to consist of $C_6H_4.SH.COOH$; this body the authors have named thihydrobenzoic acid: it fuses at 242°, is difficultly soluble in alcohol, and insoluble in water.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt. First two numbers for 1869.

Of this periodical, published by the Austrian government, one number is published at the end of each quarter of the year. Very frequently these papers contain the results of chemical researches and analyses, and these we briefly abstract:—

Phosphatic Nodules from the Chalk Formation of Russian Podolia.—Dr. Alth.—Leaving the purely geological portion of this paper, and the discussion on the origin of the phosphate nodules in general, and especially of the variety here alluded to, the author states that the result of the analysis for this mineral is, for 100 parts:—Water, 0·65; silica, 14·18; lime, 26·12; fluorine, 11·69; alumina, 0·99; phosphoric acid, 23·50; iron (*eisen*), put down as metal, 9·23; cobalt, 4·60; manganese, 1·40; sulphuric acid, 2·10; magnesia, 3·52; potassa, 1·20; loss, 0·82.

Analyses of Several Kinds of Common Salt from Galicia.—M. A. von Kripps.—This paper is subdivided into several sections. The average composition of rock-salt from Stebnik is, in 100 parts:—Chloride of sodium, 90·281; chloride of potassium, a trace; chloride of magnesium, 0·286; chloride of calcium, 0·508; sulphate of lime, 8·245; water, driven off at 160°, 0·680. Rock-salt from Kossow contains, in 100 parts:—Chloride of sodium, 98·0; alumina, 1·7; loss by heat (water driven off at 160°), 0·2. We have only selected a couple of samples from among a number of about one hundred. It appears that Galicia is very well provided with deposits of rock-salt, which is wrought out by mining processes, and that, by boring, saline springs of sufficient strength to admit of boiling down and obtaining salt thereby, are found in large numbers.

Researches on the Mineral Water of Rajec-Toplitz.—M. E. Glasel.—In a remote portion of the Comitate of Trentschin, near Sillein, a mineral spring is met with, the water of which is the subject of this memoir. The temperature of this water varies from 26·5° R. to 20·4° R. The water is colourless, devoid of smell, has a saline astringent taste, and exhibits, in its natural state, alkaline reaction. In 100 parts, the composition of the dry saline residue is quoted as follows:—Calcium, 52·63; magnesium, 33·29; sodium, 9·21; potassium, 2·83; aluminium, 2·02; oxide of iron, a mere trace; carbonic acid, 82·17; sulphuric acid, 16·57; chlorine, 1·31; silica, 0·80; phosphoric acid and iodine, a trace; free carbonic acid, 7·05; sp. gr., 1·000768.

Bulletin de l'Académie Royale des Sciences, des Lettres et des Beaux Arts de Belgique, No. 7, 1869.

This number contains only one paper relating to chemistry:—

Presence of Chloride of Sodium in the Water and Rocks of the Coal-Formation of Luijk (Liege). M. R. Malherbes.—The paper here quoted is not the original work of the author, but two reports on his paper, one of which is written by the well-known M. Omalius D'Halloy, the other by M. Dewalgue. Both these gentlemen differ from the author above-named, as regards his opinion that the formation of coal should have taken place in salt-water ponds; but they also state that it is difficult to explain why some samples of sandstone of the locality above-named should contain 0·101 per cent of chlorine, while in other samples of the same stone, and in the same locality, no chlorine is found at all. Some of the schistose rocks contain 0·085 per cent of chlorine; others, again, none of this element, notwithstanding they are found close by each other and evidently belong to the same geological formation.

Journal de Pharmacie et de Chimie, September, 1869.

This number contains the following original articles:—

Laws which Regulate the Part any Substance Plays between Two Solvents.—MM. Berthelot and Jungfleisch.—A paper on this subject, recording researches of the same nature, was published by these authors, and noted by us from the *Comptes Rendus*, therefore we do not further allude to it here.

Purifying of Bromide of Potassium.—MM. Bobierre and Herbelin.—The authors state that when bromide of potassium is adulterated, or mixed with iodide of potassium, it is, in order to detect this, only necessary to place a few grains of the salt in question on paper previously impregnated with starch paste, to moisten it, and admit a small quantity of chlorine gas, whereby the iodine is set free and the paper coloured blue. A better test, given by the authors, is the use of bromine, added to the salt after it has been placed under benzol; if the latter becomes red-coloured, iodine is present. The title given to this paper should have been "On the Detection of Iodine in Bromide of Sodium."

Preservation of Eggs.—M. Violette.—The main results of this paper are the already long-known facts that eggs may be kept in perfectly fresh state by varnishing them over with a so-called drying oil, linseed oil being preferred on account of its cheapness; poppyseed oil also answers this purpose perfectly well.

Bayerisches Industrie und Gewerbeblatt, July and August, 1869.

These two numbers, published together, contain, among the officially-published material, most excellently drawn-up and well-digested law, and police regulations, for the management and traffic of the railways of the Kingdom of Bavaria. The duties, as well as the rights, of the officials thereby employed, as well as of the travelling public, are clearly and distinctly defined, and every care and precaution is taken to insure the safety and comfort of all concerned. Even in a technical point of view, this document deserves the notice of all who have anything to do with, or authority over, railways, which, as evidenced also in Bavaria, are better managed, and with more profit to the nation at large, by the State than by private companies.

Ceramic Industry of Kronnigen, Lower Bavaria.—Dr. Wimmer.—The Kingdom of Bavaria is rich in various qualities of clay fit for the most varied kinds of pottery, from the finest china, made near Nymphenburg, to the coarse but highly refractory clay which is made up in so-called Passau melting pots. The clay referred to in this paper, after having been dried at 100° (whereby it lost 21 per cent of water), gave, on being analysed, the following results for 100 parts:—Water, and trace of organic matter (lost by ignition), 2·02; alumina, 27·42; oxide of iron, and traces of oxide of manganese, 6·88; lime, 5·60; magnesia, 0·20; potassia, 0·18; silica, in combination, 19·20; sand and free silica, 38·40. No traces, even of sulphuric and phosphoric acids, chlorine, and carbonic acid could be detected. This clay is fit only for very coarse pottery.

Schools for Brewing in Bavaria.—Dr. Zängerle.—It appears from this paper that there exist, at Munich and Augsberg, excellently arranged schools wherein everything which relates to the brewing of beer is taught practically and theoretically; and, from the enumeration of the students who attend, they being natives from various European countries, as well as from America, this instruction seems to be highly valued.

Polytechnisches Journal von Dingler, first number for August, 1869.

This number contains the following original papers relating to chemistry:—

Manner in which the Nitrogenous Substances are Divided in the Potatoes.—M. Dietzel. — This lengthy paper contains researches made by the author with a view to determine what portion of the tuber of the potato is richest in protein compounds; and since, according to this author, there exists a peculiar relation between the quantity of the fatty matter contained in this, as well as in other vegetables, he concludes that, where the largest quantity of fat is there also is relatively the largest quantity of protein. The results are quoted as follows:—The layer nearest the skin contains—Proteinoid, 14·16; fat, 0·66; quantity of proteinoid for one part by weight of fat, 21·45. Interior of tuber contains—Proteinoid, 9·50; fat, 0·38; quantity of proteinoid for one part, by weight, 25·00.

Use of a Vacuum in Brewing.—M. Jicinsky.—This paper is so entirely of a practical nature that it is not exactly suited for our pages; but the author certainly proves the great benefits brewers would gain by adopting the use of vacuum apparatus.

Second number for August, 1869.

Among the original papers relating to chemistry, we find in this number:—

Peculiar Steam-Boiler Incrustation.—M. Reichardt.—On visiting a manufactory situated on the higher portion of the Thuringian river Saale, the author noticed a boiler incrustation, which, from its very dark brown colour, appeared almost to consist of an oxide of iron containing manganese. The analysis gave the following results:—Water driven off at 100°, 2·10 per cent; insoluble in hydrochloric acid, 17·12; soluble therein, 80.78 per cent. Full analysis, in 100 parts:—Water, at 100°, 2·10; white clay and sand, 8·87; oil and pitch, 8 25; sulphate of lime, 1·80; peroxide of iron, 1·20; protoxide of iron, 0·22; carbonate of lime, 68·52; carbonate of magnesia, 9·60. The dark colour is due, not to the oxide of iron, but to the organic matter, oil, and fat, partly decomposed by the high temperature, and converted into a kind of pitch.

Chemical Investigation of Tablettes de Bouillon Russes.—M. Reichardt.—The substance here alluded to is not in commerce in the western parts of Europe, and is manufactured from the meat, not only of cattle, but also that obtained from game, which latter is very plentiful in the less inhabited portions of Poland and Russia. The researches of the author, who obtained the genuine material from a friend of his who resides in Russia, yielded the following results for 100 parts:—Water, at 180° (without any decomposition), 21·7; fatty matter, 0·22; nitrogen, 10·57; ash, 4·75; soluble in alcohol, 38·09 per cent. The author, having purposely compared these meat lozenges (for so they may be called) with Liebig's extract of meat, comes to the conclusion that the extract is superior in every respect, but that this is counterbalanced by the relative cheapness of the lozenges, and their very convenient portability and non-liability to decay.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, July, 1869.

This number contains the following original communications and papers:—

Researches on those Resins Derived from the Convolvulaceæ, which Act as Drastic Purgatives.—MM. Köhler and Zwicke.—This paper contains an historical review of the discovery and older analysis of *Scammonium jalappa*, and other substances less generally known and now obsolete in Europe, formerly used as physic, and produced by plants belonging to the natural order above named. The chemical researches of the authors are confined to convolvuline and jalapine; the former expressed by the formula $C_{62}H_{50}O_{32}$, the latter by $C_{66}H_{56}O_{32}$. These two substances behave with reagents in the following manner:—

Convolvuline is not soluble in ether, and is precipitated by it from its alcoholic solution; is entirely insoluble in benzol; when evaporated to dryness along with nitric acid, convolvuline becomes violet red-coloured upon the addition of SO_3. The acid solution of convolvuline is precipitated by alum solution. The alcoholic solution of convolvuline is not precipitated by a solution of nitrate of protoxide of mercury. Nitrate of silver produces, in solutions of convolvuline, a pulverulent, non-adhesive precipitate, immediately becoming black-coloured.

Jalapine is perfectly soluble in alcohol and ether; is soluble in benzol, but rather difficultly: but is readily taken up by benzol from its alkaline solutions when these are shaken up with benzol. Jalapine, treated as described, is not coloured at all. Acid solution of jalapine remains quite clear and undisturbed on being treated by alum solution; alcoholic solution of jalapine is precipitated by nitrate of protoxide of mercury, yielding a bulky, caseous precipitate, insoluble, also, on heat being applied. Nitrate of silver produces a bulky, caseous, whitish grey, clotted precipitate in solutions of jalapine, and this precipitate is only slowly changed by the action of the light.

These reactions may serve to distinguish between genuine resin of jalap, and between scammony and its resin.

Description of a Practical Chlorine-Water Apparatus.—Dr. Duflos.—There is added to this paper a woodcut, and, without reproducing it, it is not an easy matter to make this apparatus understood. The chief point is that the pressure of the gas escaping from a mixture of 2 ounces of dry bichromate of potassa, and 11 ounces of commercial hydrochloric acid, is made to saturate, with chlorine gas, 8 lbs. of water, by making the gas to force, by pressure, this quantity of water from one Woulf's bottle into another.

Detection of Wheaten Starch among Arrow-root, and of Wheaten Flour among Starch.—Prof. Boettger.—Take 1 grm. of the material to be tested, put it in a porcelain dish, and add 180 c.c. of distilled water; apply heat, and boil the mixture briskly while stirring continuously and briskly with a glass rod. Any starch which is quite free from gluten—for instance, pure potato starch, or pure arrow-root—will not exhibit, when treated in this way, any foam on the surface of the liquid as soon as the stirring is discontinued; but when the starch happens to contain the slightest trace of gluten, in other words, flour, there will appear on the boiling liquid, during the stirring up, a strong foam, which is so strong that it often resembles the foam on soap-sups.

August, 1869.

This number contains the following original papers:—

Gelatinæ Medicatæ in Lamellis.—Dr. Huseman.—This paper treats on the preparation of a peculiar kind of lozenges, pills, and gelatinous capsules fit to serve as vehicles for either very strong pharmaceutical preparations, which can only be given in very minutely small doses, such as atropine, strychnine, and the like, or substances which are very disagreeable to the taste, as *balsamus copaivæ*, cod-liver oil, &c. The paper is strictly a pharmaceutico-technical one, and we therefore allude no further to it.

Preparation of Pure Hydrochloric Acid.—Dr. Riecker.—The author mixes crude hydrochloric acid, sp. gr. 1·170, (containing 34·25 per cent real HCl), and sulphuric acid), sp. gr. 1·830 (containing 93 per cent. of monohydrated acid), in the proportion of 100 parts, by weight, of the latter

acid and 40 parts of the former (HCl), leaving, after distillation, whereby the HCl is volatilised, a sulphuric acid of 1·650 sp. gr. The loss of HCl in this operation amounts to about 3·5 per cent.

Cultivation of Opium in Germany.—M. Jobst.—This paper is altogether of a botanico-technical nature, treating on the mode and commercial advantages of cultivating the *Papaver somniferum* for the purpose of obtaining opium of good quality, which appears to be perfectly possible in some parts of Southern Germany.

Detection of Alcohol in Chloroform.—M. Blacher.—Add to the suspected chloroform a small piece of caustic potassa, and leave the fluid at rest for a few minutes; then add distilled water, and shake the chloroform therewith. Decant the water, and add a solution of a salt of copper to the aqueous fluid; if a precipitate ensues, the chloroform contains alcohol. Another, and perhaps more reliable, plan to detect alcohol in chloroform is to add to the latter a small piece of quite dry caustic potassa and a piece of reddened litmus-paper; if the latter becomes blue on being shaken up with the chloroform, it is sure to contain alcohol, provided always that it is quite anhydrous.

Revue Hebdomadaire de Chimie, September 16, 1869.

Names Given to Spirituous (Alcoholic) Liquids.—M. Mené.—It frequently happens that some industrial, or commercially-adopted, term, for an alcoholic fluid is not properly understood, and this especially is the case with what, in and out of France, is known as *trois six*, 3-6. All alcoholic liquids are designated according to their strength, as indicated by Cartier's areometer for spirituous liquids. Liquids from 16° to 20° are called *eau de vie*, strictly translated water of life, or life-giving. Holland proof is spirit of 19° Cartier, strong *eau de vie*, brandy marks 21° or 22°. Above that degree, the fluids are named *esprits*, *spiritus*, and, by means of certain cypher figures, written as fractions, the greater or smaller quantity of water which these fluids require, in order to be reduced to the state of ordinary *eau de vie* of 19°, is expressed; for instance, *trois six*, 3-6, is is an alcohol of 33°, three parts of which, by bulk, produce six parts of *eau de vie*. The *trois sept.*, 3·7, is alcohol at 35°, three volumes of which form seven volumes of *eau de vie* at 19°. The word brandy is, no doubt, a contraction for *brantwein*, meaning, literally, burnt wine, since real genuine brandy is obtained by the distillation of certain wines, not as such fit for beverage.

Les Mondes, September 16, 1869.

Another Successful Artesian Well.—The well-known M. Say, the owner of the most extensive sugar refinery in France, situated on the Boulevard de la Gare, at Paris, has just got completed, at his manufacturing premises, the boring of an artesian well. At 562 metres below the surface, a water layer has been reached, yielding 7000 litres of water per minute. The water, which has a temperature of 28° above zero, on reaching the surface, rises to a height of between 20 and 30 metres above the end of the bore-hole at surface level. The cost has been 300,000 francs, and the work has been completed within four years, by the successors to the celebrated MM. Mulot, St. Just-Dru.

Comparative Review of the Composition of Milk from Various Mammiferæ.—In 1000 parts of milk, the undermentioned quantities of the following substances are contained in the milk of the animals respectively quoted:—

	Water.	Butter.	Caseine.	Sugar.	Inorganic matter.
Women.....	889·08	26·66	39·30	43·68	1·30
Cows	864·20	31·30	48·30	47·70	6·00
She Goats...	844·90	56·87	35 14	36 91	6·18
Ewes.....	832·32	51·31	69 78	39·43	7·16
Mares.....	904·30	24·36	33 35	32·76	5·23
Asses	890 12	18·53	35 65	50·46	5·24
Sows.....	818·00	60 00	53·00	60·70	8·30

September 30, 1869.

Strengthening and Rendering Woven Tissues Impermeable to Water.—M. Neumann.—A sulphuric acid bath is made containing acid varying in strength from 40° to 66° Beaumé (specific gravities 1·384 and 1·850), and kept at a temperature of 57°. The woven tissues, cotton or linen, are rapidly passed through this bath, being only left in contact with the acid for from ten seconds to two minutes, according to the nature of the tissue, which is immediately after passed through very cold water, and next submitted to a thorough washing process. The effect of the action of the acid is an incipient dissolution, and formation of a varnish-like matter, which, especially after it has been regularly spread over the fabric, and incorporated therewith by hot-pressing and calendering, greatly increases the strength of the fabric, rendering it simultaneously impervious to water.

Annales de Chimie et de Physique, September, 1869.

This number is entirely filled up with a lengthy monograph, which bears the title—

New Researches on Thermo-Chemistry.—M. Berthelot.—We confine our abstraction to the headings of the different parts and sections of this paper. *Endothermic and exothermic reactions:*—Combinations formed with absorption of heat; on double decompositions; formation and decomposition of formic acid; fermentations and constitution of sugar; on compounds which develope heat when becoming decomposed and in nascent state; formation of protoxide of nitrogen and the decomposition of nitrate of ammonia; chemical action of light; on action by contact; on isomeric transformations; on the influence and effects of pressure upon chemical phenomena; changes of temperature produced by the mixing of divers fluids; general principle involved in all chemical reactions. *On pyrogenetic equilibrium:*—Decomposition of organic substances by heat. This memoir will be continued in another number of this periodical.

Journal für Gasbeleuchtung, August, 1869.

Among the original papers contained in this number we notice:—

What is Cheap Gas?—Dr. Schilling.—The contents of this paper, which is written with an evidently large amount of technical and commercial knowledge on this subject, might be very advantageously translated by our excellent contemporary, the *Journal of Gaslighting*. The idea of cheap gas is, indeed, a very relative one, since it is possible, by those well acquainted with all the *minutiæ* of gas-making, to manufacture gas which, though nominally cheap, may, by want of "durability," and even with a high illuminating power, be very expensive to the consumer.

Photometrical Studies.—M. Elster.—This paper, and the following—

Purification of Coal-Gas.—M. Buhe—are excellent treatises on the subjects, but, unfortunately, too lengthy to admit of any useful abstraction. As regards the purification of gas, it is quite clear, from the manner in which this subject has been taken up abroad, that it deserves deeper looking into than is generally done at gas-works.

Monatsberichte der Koniglich Preussischen Akademie der Wissenschaften zu Berlin, May, 1869.

This number does not contain any papers at all relating to chemistry or sciences allied thereto.

June, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Preparation of Silicic Acid in Crystalline Shape by the Dry Way.—M. Rose.—The paper is identical with that which appeared on this subject, written by the same author, in the *Berichte der Deutschen Chemischen Gesellschaft*, No. 14, 1869, from which it has been abstracted.

Relation of Chloral and Trichloracetic Acid to the Animal Organism.—Dr. Liebreich.—This paper relates a series of physiological experiments aided by chemical reactions. It appears that hydrate of chloral may become a very useful and safe anæsthetic.

Emission and Absorption of Heat Radiated at Lower Temperatures.—M. Magnus.—The author states—"Different bodies heated to 150° emit, by radiation, different kinds of heat; some bodies only emit one kind of heat. Rock salt belongs to those substances which, if it is quite pure, emit different kinds of heat. The author then enters into discussions on diathermancy, and the power of absorption for certain rays of heat; but the paper is too concisely written to admit of any further useful abstraction.

Moniteur Scientifique, October, 1869.

This number opens with a short paper on—

Artificial Alizarine.—M. Kœchlin.—To this paper is added a set of printed calico patterns, dyed in five different species of colours, viz., black, puce, scarlet, pink, and violet, respectively produced by the artificial alizarine of Messrs. Meister and Lucius, as made by them at Hoechst, near Frankfort—madder, garancine, alizarine from madder, and purpurine from madder, both sublimed. From the author's paper, it appears that the substance made by the firm just alluded to is neither artificial alizarine or purpurine, but a new compound, superior to both these substances. Alizarine, indigotine, and luteoline are correlated by the property of being crystallisable by sublimation. Purpurine does not yield solid colours until after it has been sublimed.

Test for Detecting Very Minute Quantities of Iodine.—M. Alfraise.—Take water, 100 grms., starch, 1 grm., nitrite of potassa, 1 grm.; boil this mixture during five minutes, and, after cooling, pour it in a bottle, wherein it keeps for years without deterioration. When required for use, take 10 c.c., add one single drop of hydrochloric acid. Take as much as a pin's head in size of the dry salt to be tested for iodine, place it in a clean porcelain capsule, and add one drop of the test-fluid last-mentioned. When no iodine is present, no coloration ensues; but the least trace of iodine gives rise to the formation of a well-defined blue colour. The liquid test-fluid, after addition of HCl, keeps quite well in a properly-stoppered small bottle.

Comptes Rendus des Séances de l'Académie des Sciences, October 11, 1869.

The first paper is by M. Duhamel, on the—

Principles of the Science of Forces.—This is the third portion of a work the author is occupied with, the two former parts treating of the science of numbers and the science of space. We mention the title because the writer is an excellent authority on this and kindred subjects.

Expansion of Gases.—M. Victor Regnault.—The author refers, first, to his series of experiments on this subject, made since the year 1842, and states that he believed he had found a method to determine with the same apparatus, first, the specific heat of a gas under constant pressure and variable volume; and, secondly, its specific heat under constant volume, while the pressure varies so as to leave the volume (bulk) constantly the same. Next follows the description of a series of experiments, and conclusions drawn therefrom, made at a later date; while the lengthy memoir is devoted to what the author calls simple expansion, or static expansion—that is to say, the expansion of a gas while at rest, when, by any exterior force, the space it occupies is made larger and the gas comes to rest again after the expansion. The other kind of expansion, called dynamic, is, when a gas, either while at rest or moving, expands while passing through any opening, and escapes into the calorimetric apparatus with all the velocity it has acquired. This memoir is of very great length, and the subject treated with the well-known ability of this eminent author, who, it will be remembered, satisfactorily settled the theory of the pressure of steam under various conditions.

Maximum of Force of Electro-Magnets.—M. du Moncel.—A mathematico-physical treatise.

Electricity Developed by the Dissolving of Salts in Water.—M. Raoult.—The author says the dissolution of a salt in water is a complex phenomenon whereby we distinguish—1st, the *fusion* (melting), or *disintegration* of the salt, whereby heat is absorbed; 2nd, the *diffusion* of saline molecules in water, which also absorbs heat; 3rd, the *combination* of the salt with water, whereby heat is set free. The author then states that the conditions alluded to under Nos. 1 and 2 do not produce any electricity, but that, on the other hand, the combination of a salt with water certainly does give rise to an electric current, to prove which, the author records a series of experimental results.

Condensation (Occlusion) of Nascent Hydrogen.—M. Raoult.—The author states that the small cubes of metallic nickel ordinarily met with in commerce, and which are rather porous, absorb (condense) at least 165 times their bulk of naseent hydrogen under the same conditions as palladium does. The metallic nickel employed was not pure, but was found to consist, in 100 parts, of:—Nickel, 88·4; copper, 8·1; iron 2·7; arsenic, 0·8. Perfectly pure, but yet porous, nickel exhibited the same phenomenon; but not so the compact refined, rolled, or hammered nickel.

Analysis of Raw Yellow Silks of Commerce.—M. Méne.—A series of figures exhibiting the result of the elementary and proximate analysis of a great many varieties of raw silks obtained from divers silk-producing countries of the world. The specific gravity appears to vary between 1·670 and 1·80. The elementary organic analysis is not of much use, since silk in raw state contains:—Substances soluble in water, partly nitrogenous, partly carbohydrates; fatty, resinous, and colouring substances soluble in alcohol and ether; and, lastly, the genuine fibre, a nitrogenous compound again soluble in acetic acid. It is impossible here to quote a lengthy series of figures, which is the less required since it is a well-known fact that raw silk varies considerably, according to to the food, climate, and condition of the worms which secrete this substance.

Researches on Lydine.—M. Guyot.—The author states that when he tried to prepare a certain aniline colour according to the directions given by M. Stark, by treating acid chlorhydrate of aniline with ferricyanide of potassium, and by treating the precipitate with oxalic acid, he did not succeed in obtaining a red colouring matter, as stated by M. Stark. The author obtained, however, a beautiful violet colour, which he calls *lydine*, by the following process:—100 grms. of fuming hydrochloric acid, diluted with 120 c.c.; this mixture is poured into a solution of 90 grms. of the ferricyanide of potassium (so-called red prussiate) and 850 c.c. of water; next boiled for an hour and a half, and cooled. The precipitate which has been formed is washed by decantation, and re-dissolved in a nearly saturated aqueous solution of oxalic acid, whereby the violet colour is immediately developed; and, on evaporating this solution to dryness, a paste soluble in water is obtained, which is the extract of lydine. The acid solution just alluded to may serve for dyeing silk and wool without mordants; cotton mordanted with alumina assumes the dye, also, readily. Pure lydine is a beautifully blue violet-coloured powder, soluble in alcohol, difficultly soluble in ether and benzol, and insoluble in water.

Elimination of Lime from Natural Waters by means of Oxalic Acid.—M. Monier.—Upon 100 litres of water from the Seine, 20 grms. of oxalic acid are used, previously dissolved in distilled water; an abundant precipitate is formed; after the lapse of twenty-four hours, some 85 litres of water are carefully drawn off by means of a syphon; and, on analysis, it was found that fully two-thirds of the mineral matter contained in the water had been precipitated

and the water rendered very soft. It is clear, however, that the use of oxalic acid could not be made applicable on the large scale, for various reasons, even if the acid itself was less expensive.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No 14, 1869.

This number contains the following original papers:—

Preparation of Crystallised Silica by the Dry Way.—M. Rose.—After referring to the experiments made on is subject by himself and others, the author states that he resumed his researches on this subject at the Royal Porcelain Manufactory, at Berlin, and was aided in his work by MM. Elsner and Herzog. The mineral, named adular, was fused with three times its bulk of salt of phosphorus. The fused mass was dissolved in dilute HCl; and perfectly well-defined crystals, though of very small size, were obtained; the specific gravity of these crystals varied from 2·311 to 2·317 for a series of experiments made with the same substances. The silicic acid thus obtained has the properties of tridymite. Another series of similar experiments, made with very pure amorphous silica, yielded, again, microscopically-small crystals; but their shape did not differ from those obtained with adular. A large number of similar experiments were made with different fluxes, leading to the result that the preparation of crystallised silica by the dry way, or fusion process, has as yet only succeeded in the production of crystals shaped like tridymite and opal. The author is engaged in further investigations on this subject.

Bases of the Picoline Series.—M. A. Baeyer.—Picoline is obtained when tribromallyl is strongly heated with alcoholic solution of ammonia. There is, at first, formed dibromallylamine, and, next, picoline. Aldehydine, a newly-discovered base, prepared also by this author, is homologous with picoline. During the formation of aldehydine, there are formed oxytetraldine, oxypentaldine, and also collidine.

On Cinchonine-Chinoline.—M. Lubavin.—When chinoline is heated for some days, at 100°, with fuming sulphuric acid, the result is the formation of chinosulphuric acid, $NC_9H_6.SO_2OH$. This substance is difficultly soluble in cold water, more readily so in hot water and alcohol, and insoluble in ether. When this acid is heated, along with water and bromine, at 100°, there is formed a bromated chinoline, and, not simultaneously, a bromated sulpho acid. When chinoline is treated with a concentrated solution of caustic alkali, a greenish blue-coloured substance is produced, which is also produced when cinchonine is so treated; on addition of water, this colour disappears, and there is then formed a brown-coloured amorphous substance.

Products of the Distillation of Raw Spirits.—MM. Krämer and Pinner.—The authors had an opportunity of investigating the different products which, by the distillation of spirits—that is to say, the manufacture thereof—from grain, are formed, and can be separately collected, owing to the perfection of the rectifying apparatus in use, on the large scale. Among these substances are prominent—aldehyde, acetal, propyl-alcohol, butyl-alcohol, acetic ether, fusel oil, and a mixture of different substances.

On Monobromobenzolsulpho-Acid.—M. Genz.—The acid just named has been first prepared by M. Couper. The author has obtained it by placing benzol-sulpho acid, bromine, and water in sealed tubes, and heating to 150° in an oil-bath for about five hours. After a lengthy process of purifying, a substance was obtained of which the baryta, copper, and ammonia salts were investigated, and the acid itself set free from the copper salt, by means of sulphurctted hydrogen. The acid so prepared exhibits deliquescent crystals. The baryta salt, $Ba(C_6H_4BrSO_3)_2 + H_2O$, is soluble in hot water and insoluble in alcohol. The copper salt, obtained from the baryta salt by double decomposition with sulphate of copper, crystallises readily, and is soluble in water and alcohol.

Nitro and Amido Derivatives from Cyanide of Naphthyl.—M. A Welkov.—The author prepared, from a cyanaphthyl, $C_{11}H_7N$, a nitro-compound, which crystallises from its alcoholic solution, and is composed of $C_{11}H_6N_2O_2 = C_{10}H_6(CN)(NO_2)$. From that compound, the amido base was obtained, by means of a reducing agent, the hydrochlorate of which has the formula $C_{11}H_9N_2Cl$.

Some Derivatives from Bromide of Aniline.—M. W. Otto.—Dibromated diphenylsulpho-carbamide, $C_{13}H_{10}Br_2N_2S$, a solid crystalline substance, soluble in alcohol, fusing at 178°, subliming at 200°; insoluble in water, both hot and cold, also insoluble in ether, and readily soluble in hot alcohol. Bibromated diphenylcarbamide, $C_{13}H_{10}Br_2N_2O$, also a solid substance, sublimes at about 222°, without entering into fusion. Quadribromated diphenyl-carbamide, $C_{13}H_8Br_4N_2O$, again a solid crystalline substance, difficultly soluble in any neutral menstruum. Bromated phenyl-senfol (essential oil of mustard), C_7H_4BrNS, a crystalline substance exhibiting the smell of aniseed, fusing at 60°, and soluble in alcohol and ether.

On Isomeric Xylidine.—Drs. A. W. Hofmann and C. A. Martius.—This paper, and the following:—

On Naphthaline Red.—Dr. Hofmann—are not well suited for abstraction with due regard to the contents and the labour of the authors.

Action of Cyanogen upon Anthranilic Acid.—M. Greiss.—The author, after having briefly reviewed his former investigations on the action of cyanogen upon amido-benzoic acid, treats, in this paper, at very great length, on the action of cyanogen upon a compound, $C_{10}H_{10}N_2O_2$, being a product of the action of cyanogen upon an alcoholic solution of anthranilic acid left standing by itself for several days. We regret that it is impossible to enter into further abstraction of this paper, owing to the fact that we should be obliged to reproduce so large a number of formulæ.

Description of an Apparatus for Exhibiting Combustion Experiments in a Lecture-Room.—M. Kekulé.—Without the reproduction of the two woodcuts added to this paper, it is not possible to make the description properly understood.

On Ethyl-Benzoic Acid.—MM. Thorpe and Kekulé.—The authors and M. Fittig having, some years since, synthetically prepared ethyl-benzoic acid from ethyl-benzol, the question treated of in this paper is, to decide whether the ethyl-benzoic acid obtained in this manner is identically the same as that obtained by the last-named party, by means of the oxidation of diethyl-benzol. The result of a carefully-instituted comparative research of the acids obtained in these different ways is that they are quite identical with each other.

On Acetylbenzol.—M. Glaser.—Acetylbenzol, phenyl-acetylen, $C_6H_5.C_2H$. This body has been prepared by the author from phenylpropiolic acid and styrol, and which has been obtained by MM. Berthelot and Friedel by other means, is possessed of the remarkable property of combining with metals and metallic oxides, some of which are treated of in this paper. The copper compound of acetylenbenzol, $(C_6H_5.C_2)_2Cu_2$. Diacetenylphenyl, $C_{16}H_{10}$, is a solid substance, soluble in boiling alcohol and insoluble in water; it is a peculiar hydrocarbon, obtained when acetenylbenzol copper is treated with a concentrated alcoholic solution of ammonia. Acetenylbenzol sodium, $C_6H_5.C_2Na$; this substance has only an ephemeral existence; it is instantaneously decomposed, both by moist and dry air.

Communications from the Chemical Society at Zurich, called the Chemical Harmonica.—M. Meister writes—"At the meeting held on the 27th of July last, MM. Merz and Weith spoke about acetanilide. In pure state, this substance is soluble in hot water, fuses at 113°, crystallises very readily, and is decomposed by sulphuric acid, acetic acid being set free and sulphate of aniline

formed. In order to detect acettoluide among acetanilide, the acetic compound is dissolved in four parts of glacial acetic acid, and next mixed with about eighty parts of water; hereby the acetanilide remains dissolved, while the acettoluide is precipitated. MM. Baltzer and Merz obtained, by distilling a mixture of potassium-disulphonaphthalate and cyanide of potassium, a peculiar cyanide of high melting point, soluble in hot alcohol; this dicyannaphthaline is entirely acidified (*acidificirt*) by treating it with alcoholic solution of potassa, or by HCl at about 199°, while ammonia is at the same time generated.

Derivatives from Uramidobenzoic Acid.—M. Greiss.—Uramidobenzoic acid, $C_8H_8N_2O_3$, is prepared by the action of a mineral acid upon a peculiar basic compound, $C_{20}H_{30}N_4O_9$, obtained by the action of cyanogen and an alcoholic solution of amidobenzoic acid. In this lengthy monograph, the author treats of several derivatives obtained from the uramidobenzoic acid by the action of nitric acid; among these new compounds, dinitro-uramidobenzoic acid, $C_8H_6N_4O_7$, is soluble in alcohol and ether, yielding, on evaporation, well-defined crystals. The paper is too concisely and abstrusely written to be fit for further condensation.

Illustration of the Phenomena of Combustion for Lecture Experiments.—Dr. A. W. Hofmann.—We greatly regret that, in consequence of the absolute necessity of the woodcut added to this paper, for it to be properly understood, we cannot abstract this communication of the eminent author.

Nature of Aniline Green.—MM. Hofmann and Girard. —We have briefly noticed this memoir (see CHEMICAL NEWS, vol. xx., p. 153—*Amer. Repr., Nov.*, 1869, *page* 312). This German paper is identical with the French one already alluded to.

On those Compounds of Essential Oil of Mustard which are Isomeric with Hydrosulphocyanic Acid.—Dr. A. W. Hofmann.—This is the fifth paper on this subject, not well suited for condensation with due regard to the labour bestowed upon the contents by the learned author.

Researches on the Products of Desulphuration of Diphenylsulphocarbamide.—Dr. A. W. Hofmann. —This memoir is too lengthy and too concisely written for any useful abstraction.

On some Superiodides.—M. Jörgensen.—This paper is an abstract of a larger memoir on this subject. The author treats of the superiodides generated when neutral or acid solutions of the hydrochlorates of morphia, codeia, papaverine, narceine, and narcotine are treated with solutions of iodine in iodide of potassium, in which case superiodides are formed which exhibit crystalline structure. Tetraiodide of morphia, $C_{17}H_{19}NO_3HI_4$, is precipitated in crystalline form when, to the aqueous solution of the salt of morphia, an excess of iodide of potassium is added. Teriodide of codeine and teriodide of papaverine, the former, $C_{18}H_{21}NO_3HI_3$, the latter, $C_{20}H_{21}NO_4HI_3$, have been found to contain hydriodic acid, since the alcoholic solutions, when shaken up with metallic mercury, yield double salts, only containing two equivalents of mercury. Sesquiiodide of narceine, $(C_{23}H_{29}NO_9)_2H_2I_3$, is formed when a very dilute solution of the hydrochlorate of the alkaloid is left standing for several weeks, after having been mixed with a dilute solution of superiodide of potassium. The author has extended his researches to piperine, atropine, berberine, theobromine, chinine, cinchonine, methylchinine, methylchinidine, ethylchinine, and ethylcinchonine; also to tetrethylphosphonium; but the great length and the large number of formulæ contained in this paper forbids us entering into more details on this subject.

This number of the periodical contains the queries to which answers are requested:—1st. By the Royal Prussian Academy of Sciences at Berlin; to be replied to before the 1st of March, 1870. The question proposed is the synthesis of either one or more such alkaloids as chinine, cinchonine, morphine, strychnine, brucine, or any non-nitrogenous compounds so related to these bodies, that, by the action of ammonia, it can be converted into the aforesaid bases; prize, 100 ducats, about £50. For 1872, the same premium for a full investigation of the nitrogenous substances contained in wheaten flour and rye flour, and the changes these substances undergo when acted upon by water. 2nd. The Association for the Promotion of the Industry of Prussia asks —The preparation of an enamel on cast-iron, of variegated colours, to be unaffected by exposure to air, and to have proved effectual for at least one year; premium, 300 thalers (£45). For a suitable substitute for the use of arsenic acid in the manufacture of fuchsine (aniline red), provided the substitute be no more expensive and not poisonous or dangerous to deal with; a gold medal, or 1000 thalers (£150). For good replies to the subjoined questions, the same premium:—(1) A method whereby the quantity of aniline and toluidine contained in commercial aniline (*anilinöl*, literally aniline oil) can be accurately, readily, and speedily determined; (2) to determine the influence which the various mixtures of these two substances have in regard to the quantity of aniline obtained; (3) to estimate what weight will yield the largest quantity of crystallised pigment. These three particulars have each to be answered in order to satisfy for the premium. The last meeting of the Chemical Society of Berlin was held on the 11th of October, this being the report of the meeting held on July 26th last.

Bulletin de la Société Chimique de Paris, September and October, 1869.

These two numbers have been published together, and contain the following original matter:—The *proces verbaux* of the meeting of this Society, held on the 2nd and 16th of July last, from which we learn that M. Personne described two new combinations of sulphuric and pyrogallic acids obtained by him. One of these, a conjugated disulphuric acid, exhibits needle-shaped crystals; its baryta salt is efflorescent. This compound is accompanied by a blue substance, a product of oxidation. In addition to these, there is formed a monosulphuric acid, a solid substance, crystallising in large crystals, which, on the addition of baryta, yields a beautiful purplish colour. The author has estimated the sulphuric acid in these compounds by burning them in a current of oxygen gas, and conducting the products of combustion into a solution of permanganate of potassa, and precipitating the sulphuric acid by means of baryta. M. Grimaux spoke on a new kind of nitriles, the oxygenated nitriles of the aromatic series. Salicylo-nitrile, C_7H_5NO, is obtained by the dehydratation of salicylamide by keeping it at a temperature of from 280° to 300°. The new product is a solid body, crystallising in yellow-coloured crystals, fusing at about 285°; almost insoluble in ether, alcohol, chloroform, sulphide of carbon; soluble in 200 parts of boiling oil of turpentine, soluble in aqueous and alcoholic solutions of caustic potassa, and, by fusion with that substance, is transformed into salicylic acid.

The following papers and memoirs were read:—

On a Homologue and Isomer of Choline.—M Wurtz.—This paper is chiefly intended to point out the identity of neurine and choline, which last-named substance was originally found by M. Strecker in bile, while neurine, as discovered by the author of this paper, is artificially produced by the action of triethylamine upon hydrochlorate of glycol.

Action of Hydrochlorate of Glycol upon Toluidine.—M. Wurtz.—The author describes the action of hydrochlorate of glycol upon aniline and toluidine, exposing at great length the different reactions which take place, and the preparation of divers salts, especially with platinum as basis. The memoir is too lengthy to admit of useful abstraction.

Synthesis of Naphthalin-Carboxylic Acid.—M. Eghis.—This acid is obtained by acting with sodium amalgam upon a mixture of monobromated naphthalin and chloroxycarbonic ether. The acid so obtained appears to be identical with the menaphtoxylic acid of M. Hofmann, but differs from the carboxylic acid obtained by means of the cyanide of naphthyl prepared from sulpho-naphthylate of potassium by M. Merz.

Action of Anhydrous Sulphuric Acid upon Perchloride of Carbon.—M. Schutzenberger.—There is produced a liquid boiling at 130°, decomposed by water into sulphuric and hydrochloric acids, fuming in the air, and giving off a smell which is similar to that given off by some of the chlorides of the metalloids. The action of anhydrous sulphuric acid upon tetrachloride of carbon is represented by the following formula:—$S_2O_6+CCl_4=CCl_2O+S_2O_5Cl_2$.

Synthesis of Glucosides.—M. Schutzenberger.—The chief result obtained by the author is that the synthesis of genuine glucosides which agree in their properties with those formed naturally is possible by means of the double decomposition of the acetic glucoses (*glucoses acétiques*) and the lead or soda salts of several organic principles. The author is engaged in further researches on this subject.

Acetic Derivatives of the Sugars.—MM. Schutzenberger and Naudin.—This paper is too lengthy and too concisely written to admit of useful abstraction.

Inuline and its Acetic Derivatives.—MM. Ferrouillat and Savigny.—The authors have prepared inuline from dahlia root and from the root of the inula helenium. Notwithstanding that these substances have been carefully manipulated, so as to ensure the purity of the inuline, it appears that, from the experiments made, that this substance, as obtained from either of the two roots named, does not behave in the same manner when treated with acetic acid under exactly similar conditions, but yields products of decomposition which vary greatly. It is impossible to enter into details about these researches, since the paper is too lengthy for that purpose.

Oxidation of Pseudoctylic Alcohol.—M. Clermont.—The products obtained are the same as those yielded by castor-oil when it is oxidised.

Action of Permanganate of Potassa upon Cinchonine and the Existence of a New Alkaloid of the Cinchona Species.—MM. Caventon and Willm.—We have given an abstract of this from another publication.

Salts of Phenetosulphuric Acid.—MM. Opl and Lippman—Phenetol is—

$$\left.\begin{matrix}C_6H_5\\C_2H_5\end{matrix}\right\}O$$

It boils at about 169°. The authors describe a baryta salt of this substance, $(C_6H_4SO_3,C_2H_5O)_2Ba''+4H_2O$, a phenetolsulphate of baryta, nearly insoluble in cold, but soluble in hot, water. Phenetolsulphate of lead, crystallising in cauliflower-like masses, soluble in water. Phenetolsulphate of potassium—

$$\left.\begin{matrix}C_6H_4SO_3K\\C_2H_5\end{matrix}\right\}O+H_2O$$

is obtained by decomposing the baryta salt by means of carbonate of potassa. The salt obtained is readily soluble in water, and crystallises in needle-shaped crystals.

Structure of Cubical Pyramidal Crystals.—M. Wyrouboff.—This paper is not suited for abstraction, being a strictly crystallographico-geometrical paper.

Cresotic and Salycilic Acids.—M. Vogt.—By means of a complicated process, commenced by acting upon chlorinated xylen with fuming sulphuric acid, an acid has been obtained which is soluble in hot water, insoluble in cold water; soluble, also, in alcohol and ether, and violet-coloured by salts of iron. This acid is composed, in 100 parts, of:—C, 63·1; H, 5·12; O, 31·78. When toluen was treated in the same manner, salicylic acid, $C_7H_6O_3$, was obtained.

Succinate and Benzoate of Isopropyl.—M. Da Silva.—We have already abstracted the contents of this memoir, which was also published in another periodical.

There is added to this number a loose sheet, bearing title—

Ecole Superieure des Sciences Appliquees de Mulhouse.—(*Laboratoire de Chimie*).—From this programme, approved and signed by the Recteur de l'Académie de Strasbourg and other authorities, we learn that there exists at Mulhouse an excellently-arranged school for the education of those who are either to be the heads or future managers of industrial works of various kinds. There is attached to this school a large and well-fitted chemical laboratory, wherein every opportunity is given for practical working, and at a very moderate expense, considering that thirty hours a-week are devoted to chemistry alone. The regular course of this school extends over two years, after which period those who desire it are examined, and certificates are granted, which are considered as rigorous proof of real efficiency. This school is, in miniature, what the celebrated Ecole Centrale des Arts et des Manufactures at Paris is on a large scale. Both these schools were originally established by private enterprise, and have become highly and deservedly esteemed, and are therefore fully approved of by the authorities of the Université de France.

Polytechnisches Journal von Dingler, first number for September, 1869.

This number contains the following original papers relating to chemical science:—

Proper Mode of Applying Zinc-White as a Pigment.—Dr. Dingler.—The author disapproves of the use of any substances containing lead, or any preparations thereof, along with zinc-white. He recommends, instead of the use of ordinary boiled linseed oil, to mix the zinc-white with an oil prepared in the following manner:—200 lbs. of linseed oil are gently boiled, first, for some five or six hours alone, and, next, boiled again along with 24 lbs. of coarsely-broken-up peroxide of manganese for at least twelve hours; in this manner, a very quickly-drying linseed oil is obtained, which is eminently fit for the purpose of being used with zinc-white and other zinc colours. The author lays stress upon the use of old linseed oil, and also upon the care to be taken with the boiled oil, which, unless carefully kept from access of air, becomes thick in a very short time. The boiled oil so prepared ought not to be used in painting with zinc-white, by itself alone, but should be mixed, in quantities of from 3 to 5 per cent, with the raw linseed oil used to mix up the paint.

Optical Milk Test.—Dr. Heeren.—This is a lengthy essay on a subject of great importance. The author points out that chemical analysis only is the proper mode of testing the quantity of butter contained in milk; but he also observes that this requires more knowledge, and also more time than those practically interested in this subject can devote to it. The author then reviews a variety of instruments devised for the purpose of testing milk; among these, M. Chevalier's crëmometer is noticed. In the first place, the awkwardness of this instrument is due to the fact that the milk has to stand therein for at least twenty-four hours; and, although for milk intended for butter-making this is no objection, it is not desirable for daily use. The optical milk-testing apparatus devised by M. Donné, in the year 1843, and M. Vogel, in 1862, are described, and their value reviewed. The general results obtained by this author may be recapitulated as follows:—Skimmed milk contains fat globules of smaller size than unskimmed milk; smaller globules produce a relatively greater turbidity than larger-sized globules. Since the value of the optical milk-test is

based upon the degree of non-transparency, it cannot yield correct results for wholly or partly skimmed milk. Carefully-made experiments prove that the use of M. Vogel's galactoscope gives perfectly correct results, but only for pure and unskimmed milk. By means of a combined optico-chemical investigation, it is possible to detect the precise quantity of fatty matter withdrawn from milk. The increase of the specific gravity of milk by skimming it is in direct proportion to the quantity of fatty matter withdrawn.

Quantitative Analysis of Soap.—M. Span.—Too lengthy to admit of useful abstraction.

Crystalline Coloured Substance Prepared from Mica.—Dr. Tech.—This paper contains the results of researches made with the view to detect the colours applied to minute pieces of mica used for ornamental purposes under the name of *brocate*. The following colours were tested:—*Rose red.*—Proved to be cochineal. *Carmine red.*—The colour is soluble in hot water; ammonia destroys the colour, HCl makes it yellow; colour is soluble in spirits of wine; the colour of that solution is destroyed by ammonia; colouring matter is, therefore, fuchsine. *Violet.*—Hardly soluble in water; completely soluble in water acidified with acetic acid; discoloured by ammonia; turns first green, and then yellow, by addition of hydrochloric acid. *Bright blue.*—Insoluble in water and water acidified with acetic acid; insoluble in alcohol; soluble in aqueous solution of oxalic acid; discoloured by alkalies. *Berlin blue.*—Deep blue; as far as tests could prove, this appeared to be Girard's violet, green, a mixture of aniline blue, and turmeric. Violet blue was evidently obtained with log-wood, and this was also applied to black.

Non-Porous Copper Castings may, according to the editor, be obtained by melting copper in plumbago crucibles previously lined inside with pipe-clay and dried. As soon as copper, while in molten state, is in contact with coal or carbonaceous matter, it yields a porous and spongy casting.

Pharmaceutische Zeitschrift für Russland, August, 1869.

This number contains the following original papers:—

Contributions to a Monograph on Inuline.—M. Dragendorff.—This paper is the first instalment of a memoir on inuline; it contains—(1) an historical introduction; (2) an essay on the different species of plants and parts of plants in which inuline is found; to these belong *Inula Helenium*, L., *Taraxacum officinale*, *Cichorium Intybus*, *Anacyclus officinarum*, *Helianthus tuberosus*. Inuline (also known as *helenin*, *alantin*, *dahlin*, *menyanthin*) is chiefly contained in the roots of the plants alluded to; it is a substance isomeric with, and in its properties similar to, starch, and was discovered in 1804 by M. V. Rose; its formula is $C_6H_{10}O_5$. The paper on this subject is to be continued.

Comparative Essay on the Characteristic Properties of the Halogens and their Combinations, and particularly on Hyperiodic Acid.—M. Ferrein.—This is the last instalment of a very lengthy essay on this subject.

Method for Rapidly Separating the Nitrates of Silver and Copper from each other.—Dr. Palment.—The author had to prepare nitrate of silver from small silver coins which contained a large percentage of copper. The alloy is dissolved in nitric acid; the solution is filtered if necessary, and evaporated until it has the consistency of a thickish oil; when this point is reached there is added to the solution very concentrated nitric acid free from HCl. By this proceeding all the nitrate of silver is precipitated, while nitrate of copper remains in solution. One part of the concentrated metallic solution requires from three to four parts of nitric acid for the complete precipitation of the nitrate of silver; the more concentrated the nitric acid is so much the better, but acid of 1·250 sp. gr. answers the purpose. The solution of copper is decanted off, and the nitrate of silver washed with nitric acid.

Researches on the Excrements of the Silk-worms.—Dr. Palment.—These excrements contain 13·33 per cent ash, composed of potassa, soda, a trace of magnesia, carbonic, sulphuric, phosphoric acids, and chlorine. Among the organic substances contained in these excrements, the author found starch, mucus, sugar, tannin, and a peculiar green pigment. The worms had been fed only on the leaves of the white mulberry tree.

On Jantak-Schakar.—Dr. Palment.—Under this name there is sold in the towns of Central Asia a yellowish-coloured, dirty, hygroscopic substance, which is used as sugar, but the author has not been able to learn how it is obtained and from what plant it is derived; he found it did not contain mannite, and yielded on analysis, in 200 parts:—Sugar, 56; water, 11·4; impurities, 21·7; the latter being partly woody fibre, and partly inorganic salts.

Researches on a Petroleum from the Kirgisensteppe.—M. Both.—This oil occurs in wells at a considerable distance from Orenburg; its colour is brownish-black, its consistency like tar; specific gravity, at 14°, 0·87; it contains 17 per cent of water, wherein 0·80 per cent of sulphate of protoxide of iron, readily soluble in ether, alcohol, benzol, chloroform, oil of turpentine, and miscible in every proportion with fatty oils; boiling point, 380°. This oil is purified with great difficulty; it contains 1·87 per cent of sulphur.

Les Mondes, October 7, 1869.

This number contains the following original communications:—

On the Radiant Heat from the Moon.—M. Marié-Davy.—The author says:—I do *not* admit that there is any essential difference between light and heat; I do not say that the *vis viva* of the moon's rays is *nil*, but I say it is so infinitesimally small that it is incapable of raising the temperature of an air-thermometer upon which the moon's rays concentrated by a strong lens were directed 0·0004°; and the heat radiated is not sufficient to raise the temperature 0·000001° when the bulb of the thermometer is directly exposed to the moon's rays. Suppose we apply either a lens ten times stronger than the one we employed, or a thermometer ten times more sensitive, and we thereby magnify the effects of course so that a motion of 1 m.m. will take place which will be very perceptible. If my observations were contradicted by those made by the late Lord Rosse, that nobleman ought to have drawn from his observations the conclusion that the direct rays of the moon were capable of elevating the temperature of a thin blackened object 0·00001°. The sun's rays increase about 12° the temperature of a thermometer placed in an apparatus invented by the Rev. Father Secchi, S. J., the obvious result of my observation alluded to above would lead to the result that the *vis viva* of the sun's rays is 12,000,000 times larger than those of the moon's rays. The moon by no means reflects the total quantity of rays which she receives, and since, in all probability, its radiation is diffuse, it follows that its rays when arriving upon our planet are weakened in the ratio of the square of the diameter of the moon's orbit and of the diameter of the moon itself. The moon's rays are not necessarily of the same composition as those of the sun, and it is a well-known fact that the calorific power is not proportionate to the illuminating power in the sun's spectrum. A common argand lamp placed at a distance of two metres from my experimental thermometer by the heat radiated from it caused the mercury to move through more than 1 m.m. of space, while the moon's image, though giving far more light, did not cause the mercury to move at all.

Naphtha as Fuel for Locomotive Engines.—M. Portski.—This Russian engineer has run a railway train

successfully for a distance of 81 versts* from Charff to Kutschigan, the ouly fuel applied being raw commercial naphtha, instead of coal, coke, or wood.

The Journal of the Franklin Institute, August, 1869.

This number contains the following original papers and communications:—

Old and New Coal.—Dr. Morton.—The author says:—Attention has been lately drawn to a curious observation, which is given as a fact without sufficient explanation. In one case, where hard coal is used in large quantities for purposes of mere evaporation, it appears that some which has been kept on hand in open piles for five or six months is less effective by from 13 to 15 per cent than that fresh from the pit. The deterioration caused by the absorption of water is, of course, well known, but does not seem to apply to these cases. The fact here alluded to is very well known in this country (England), and also elsewhere on the European continent, but is not quite scientifically explained.

The New Chemical Nomenclature.—Dr. Ott.—This is the first portion of a lengthy paper which the author intends to publish on this subject. He says—"The deficiency of the present system of chemical nomenclature, though immensely felt for many years, has been chiefly brought to light by the astonishing strides of organic chemistry." The author points out the great inconvenience of a nomenclature containing names with seventeen or more syllables; though, in a less distinct manner, this deficiency is also felt in the domain of inorganic chemistry. We meet here such scarcely pronounceable denominations, as "hypersulpho-molybdate of potassa," "sesquibasico-ammoniaco-sulpharseniate of soda," and many others. The author proceeds to point out that the history of the spoken language of chemistry shows more clearly than that of any other science its various conditions in the succeeding stages of progress. The early cultivators of science hid their doctrines under the veil of an obscure figurative language, adopting at the same time particular characters for signifying bodies known to them. In the belief that the celestial bodies exercised a direct influence on terrestrial products, they consecrated the metallic and other substances to the seven so-called planets. As instances, we mention that to Saturn were consecrated the lead, litharge, and agate; to Jupiter, tin, corals, all white stones, and sulphur; to Mars, the iron, loadstone, and pyrites, and so on. Traces of this nomenclature yet remain in such terms as *Arbor Dianæ*, tincture of Mars, Martial pyrites, and lunar caustic. The term *sal* has been used since the oldest times for everything tasting like salt, or even for such substances as carbonate of potassa, which share only some properties with the same—viz., solubility in water, deliquescence, and colour. As instances of figurative expressions, we meet with *aqua ardens*, for alcohol, *lapis aquilinis*, &c. The author proceeds in this manner, passing in review the history of chemistry, but what has been quoted sufficiently exhibits the wide range he has taken for the full treatment of an interesing subject.

Camphoric Acid and some of its Combinations.—M. Fairthorne.—By repeated distillation of camphor with nitric acid, that substance is converted into camphoric acid by absorption of six equivalents of oxygen. The composition of camphor being $C_{20}H_{16}O_2$, that of camphoric acid is $C_{20}H_{14}O_6 + 2HO$. It (the acid) dissolves freely in alcohol and ether, moderately in water, but is soluble in benzol and chloroform. It combines readily with ammonia and other alkalies; the ammonia salt crystallises in silky, star-like crystals. Its aqueous solution behaves, with the substances hereafter named, in the following manner:—With perchloride of iron, a light brown precipitate; no precipitate with the proto salts of iron; with sulphate of copper, a bright green precipitate; with solutions of salts of lead and mercury, dense white precipitates; no precipitation with sulphate of zinc, sulphate of morphia, sulphate of quinine, sulphate of cinchonia, sulphate of magnesia; none, also, with lime-water or soluble salts of silver. The author proposes to use the peculiarly bright green coloured precipitate yielded with sulphate of copper as a test for copper, since even 1 grain of sulphate of copper in a pint of water yields a distinctly perceptible colouration.

Cosmos, October 9, 1869.

Test for Berlin Blue.—The late M. Nicklès.—Shortly before his death, this *savant* pointed out that, when woven fabrics dyed with Berlin blue are steeped in a solution of fluoride of potassium, and then submitted to the action of steam, the colour of the tissue is at once discharged. Fabrics dyed with indigo or with aniline blue, when submitted to the same treatment, remain unchanged.

Drying of Wood.—For this purpose, the wood is kept for some hours under boiling water, whereby all its soluble parts are withdrawn. It is next left to dry, and then boiled for some time in a solution of borax, which causes the albumen to become soluble, and to escape from the pores. After this proceeding, the wood is placed in stoves heated by steam, and, in three days after the commencement of this series of operations, it has become quite dry and thoroughly seasoned.

Comptes Rendus des Séances de l'Académie des Sciences, October 18, 1869.

This number contains the following papers bearing upon chemistry and allied sciences:—

Metrical System: Critical Examination of the History of the Metre.—M. Chevreul.—From this lengthy paper we learn that, on the 14th of April, 1790, M. Brisson was the *savant* who proposed that a unit of measure should be taken from nature, by reading, at the Academy of Sciences, a paper "On the uniformity of measures of length, capacity, and weights, and on a new method of constructing the toise to be used as a standard." This paper of M. Brisson was written in consequence of the proposal made by the Bishop of Autun, as a member of the National Assembly, to render a uniform system of weights and measures compulsory by law throughout the entire French Kingdom. The unit of measure of length proposed by M. Brisson was the length of the pendulum beating seconds at the latitude of Paris, which length had been very exactly determined by M. de Mairan, and found to be equal to 3 *pieds*, 0 *pouces*, 8 17-30ths *lignes*, French measure. The Commission des Poids et Mesures, which was appointed after Mr. Brisson had made his proposal, preferred the 10,000,000th part of a quarter of the meridian of Paris as unit. The law of the 18th Germinal of the year III. (April 7, 1795) fixed the length of the metre, provisionally, at 3 *pieds*, 11·442 *lignes*. The law of 6 Messidor, year VIII. (June 25, 1800), fixes the length of the metre at 3 *pieds*, 11·296 *lignes*; the difference being —0·146. This length is the legal length of the metre, and is represented by an *étalon prototype* (invariable standard) deposited with the Academy. From 1836 to 1840, M. Puissant found there was an error in the calculation of the meridian distance of Mountjouy to Formentera; and, accordingly, he found that the length of the metre should be 3 *pieds*, 11·375 *lignes*. The author of this paper comes to the conclusion, however, that, notwithstanding the slight errors found by MM. Puissant, Bessel, and others, the length of the standard metre, which is only 00·079 *lignes* different from the truth, is to be adhered to, also because of the very great inconvenience any change would cause, which is, after all, not essentially required for the uses of daily life.

* There are in use two kinds of measures called versts in Russia, which differ rather considerably in value, but one of these measures is only used in the Baltic provinces of Russia; the verst more generally in use has a value of 1066·78 metres, the English statute mile being equal to 1609·315 metres; 81 versts is therefore equal to 53·6 English miles.

Making of Standards of the Metrical System:—M. Jacobi.—This Russian *savant*, who, during his sojourn at Paris, was present at this meeting, read a paper on this subject, with the view of generalising the metrical system by the preparation of a large number of new standards made according to those deposited with the Academy, so that every centre of civilisation in Europe and elsewhere may possess one.

Oxidation of Pyrogallic Acid.—M. Aimé Girard.—The author of this paper points out that, when pyrogallic acid is oxidised in the presence of an acid, the products of its oxidation are different from those which are formed when the oxidation takes place in the presence of an alkali. Among the products there is one, $C_{40}H_{16}O_{18}$, which is a beautiful red-coloured substance, analagous to alizarine, and suitable to be used as a dyeing material. This substance is converted into picric acid by the action of nitric acid.

On Esmarkite.—M. Des Cloizeaux.—Esmarkite is a greyish-green coloured mineral; its fracture is conchoid; hardness holds the middle between apatite and orthose; sp. gr. 2·737. Composition, in 100 parts:—Silica, 47·50; alumina 33·70; lime, 15·40; magnesia, 0·56; soda, 1·84; potassa, 0·50; water, 0·94.

Observations of M. Victor Regnault on a Letter from Dr. Bosscha.—This lengthy paper contains a large amount of valuable matter in reference to thermometers, and among it the following:—The mercurial thermometer is not an instrument fit for being applied to the measurement of temperatures in experiments of precision, since it is not comparable (*manque de comparabilité*). Every mercurial thermometer which is to be applied for rigorously-exact experiments should be previously compared with a well-constructed air thermometer, both for degrees of temperature between 0° and 100°, as well as for higher temperatures. The learned author distinguishes three kinds of mercurial thermometers, viz:—Standard thermometers, indicating from −10° to +110°; thermometers for high temperatures, graduated from −10° to +350°, but which should no be exposed to a heat higher than 300°; very sensitive thermometers for calorimetrical use, indicating from 0° to +30°. The mercurial thermometer is only a thermoscope; its indications should be converted into degrees of an air thermometer.

Electro-Chemistry: Physical Method to determine the Molecular Groups which are Decomposed by a Galvanic Current.—M. Bourgoin.—According to this author, the electrolytic decomposition suffered by any compound indicates the grouping of the molecules of which that compound is made up; for instance, when sulphate of soda is decomposed by a galvanic current, it becomes evident, from the products of the decomposition, that the anhydrous salt has suffered dissociation, but not its hydrate; in other words, that the water remains inactive in this process.

Cause of the Ripening of Wines.—M. Béchamp.—The author demonstrates in this paper, at great length, that the same causes which bring on the decay of wine also act in maturing them, and giving them the precious properties recognised as *old*. It is impossible to enter into the details of this subject, which is, of course, practically important only to wine-growing countries; but it appears, after all, that scientific research on this subject is not yet quite exhausted, neither has it so elucidated this matter as to render it of easy practical application.

The American Journal of Science and Arts, vol. xlviii., No. 143, September, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Nature and Duration of the Discharge of a Leyden Jar Connected with an Induction Coil.—Mr. O. N. Rood.—This paper is the first part of a memoir read before the National Academy of Sciences. It is copiously illustrated with well-executed woodcuts, which are essential to the understanding of the paper.

On Durangite, a Fluo-Arsenate from Durango, in Mexico.—Mr. Brush.—The author states that he obtained, from a gentleman residing at San Francisco, a bright orange-coloured mineral, found at the locality above named. The hardness of this mineral was 5, sp. gr. 3·95 to 4·03; it blackens on being moderately heated in a close tube, but regains its colour again on cooling; at a higher heat it fuses to a yellow glass, and gives a faint white sublimate; it fuses readily in reducing flame, gives a strong arsenical odour, and coats the charcoal with a faint white volatile sublimate. The mineral is only partially attacked by chlorhydric and nitric acids, but is completely decomposed by sulphuric acid, with evolution of fluorhydric acid. Qualitative examination showed the presence of arsenic acid, alumina, iron, manganese, soda, lithia, and fluorine. Search was made for other metallic and mineral acids and chlorine with negative result. The following is the result of quantitative analysis in 100 parts:—Arsenic acid, 55·10; alumina, 20·68; peroxide of iron, 4·78; protoxide of manganese, 1·30; soda, 11·66; lithia, 0·81 fluorine, undetermined, but present in very considerable quantity.

Remarks on the Galvanic Battery.—Mr. Hough.

On Nitric Acid and Chlorate of Potassium as an Oxidising Mixture Applicable to Sulphur, Sulphides, Chromium, Arsenic, and Organic Matters.—Mr. F. H. Storer.—This interesting paper will soon appear in full.

Action of Light on Uranium.—Mr. Bolton.—This memoir contains an historical and experimental review of whatever is known in relation to the action exercised by light upon uranium. The paper is too lengthy for any useful abstraction.

Action of Alkaline Nitrites upon Uric Acid and its Derivatives.—Dr. W. Gibbs.—After referring to the labours of M. Baeyer on this subject, the author describes, at great length, a series of experiments made by him. This paper has, however, been forestalled by a communication of the author written to Berlin, and abstracted by us from the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin* (see Chemical News, vol. xx. p. 131, *American Reprint, Nov.* '69, *page* 311). The original paper was read before the National Academy of Sciences on April 15th last.

On the Meteoric Stone which fell December 5th, 1868, in Franklin Co., Alabama, U. S.—Mr. Brush.—This paper first relates, at length, the history of the circumstances attending the fall of this stone, which, on being received by the author, weighed 615 grms; sp. gr., 3·31; soluble in HCl, only about 26 per cent. Result of analysis, in 100 parts:—Silica, 51·33; alumina, 8·05; ferrous oxide, 13·70: chromic oxide, 0·42; magnesia, 17·59; lime, 7·03: soda, 0·45; potassa, 0 22; sulphur, 0·23; a trace of nickeliferous iron.

On Lesleyite of Chester Co., Penn, and its relations to Ephesite of the Emery Formation near Ephesus, Asia Minor.—Mr. Smith.—The author states that some years ago he analysed and described, mineralogically, under *emery*, the last-named mineral. The lesleyite has great similarity therewith. It is of a pearly white colour, and lamellar in structure; scratches glass easily; sp. gr., 3·15 to 3 20: heated before blowpipe, it becomes milk-white, but does not fuse; it is decomposed with great difficulty, by fusing, by carbonate of soda, even with the addition of a little caustic soda. Ephesite, in 100 parts, contains:—Silica, 30·70; alumina, 55 67: lime, 2·55; soda, 5·52; potassa, 1·10; water, 4·91. Lesleyite, in 100 parts:—Silica, 31·18; alumina, 55·00; lime, 0·45; soda, 1·20; potassa, 7·28; water, 4·80.

Artesian Wells at Terre Haute, Indiana.—Prof. Guyot.—Under the direction and at the expense of M. Chauncey Rose, a well has been bored, and a very exact ac

count has been made of the thickness of the strata passed through and of the fluids met with:—At 840 ft., show of oil; 1276 ft., lubricating oil; 1335 ft.. vein of fresh water; 1629 ft., oil vein; 1658 ft., blue sulphur water; 1710 ft, white sulphur water; 1768 ft., more white sulphur water; 1685 ft., large flow of white sulphur water, at the rate of 6000 gallons an hour. The temperature of the water at that depth is not quoted, neither is any further account given thereof; there is no statement, also, of the height above sea level of the surface of the bore-hole on the ground.

Sulphur Deposits of the Island of Saba, Netherlands, West Indies.—Mr. Higgins.—The island of Saba belongs to the volcanic range of the Carribee or Windward Islands. The rock composing almost the entire formation of Saba is trachytic porphyry, which contains glassy felspar and hornblende in crystals, disseminated through a dark reddish coloured base. The sulphur deposit is located on the northern part of the island of Saba, and extends for a distance of more than a mile along the sea line. The stratum of sulphur varies in thickness from 15 to 50 feet; its elevation above sea level varies from 45 to 200 feet. This island has a surface of 16·5 square kilometres (about 9 English square miles, or 5760 acres), and contains 1794 inhabitants; it has been a Netherlands dependency for nearly 200 years, and is a portion of the Government of Curaçoa, along with Aruba, St. Martin (a portion), Bonaire, and St. Eustatius.

Journal für Praktische Chemie, No. 12, 1869,

This number contains the following original paper:—

Analysis of the Medicated Spring of Tonisstein, and of the Chalybeate Spring at the Same Place.—Dr. R. Fresenius.—To many of our readers who have made a trip on the Rhine, the Brohl-Thal will have been a pleasant excursion, and to those who made that trip, the two springs just alluded to will be well known. The author of this paper has divided it into two chief sections and several subdivisions. The medicated spring of Tönisstein has been known even so far back as the time when the ancient Romans occupied that country; and in the year 1864, the Prussian Government caused the spring to be properly cleansed out, and, by means of suitably-arranged masonry and tubing, to exclude any extraneous water. The water of this spring, which is evidently forced up by a pretty strong pressure of a constant stream of carbonic acid gas, is quite clear and very sparkling, owing to the carbonic acid gas constantly escaping from the spring; its taste is pleasant, but at the same time saline. The spring yields, on an average, 4908 litres of water in twenty-four hours, while, at the same time, there escapes a quantity of 650 litres of free CO_2; the temperature of the water was found to be 10·8°, while the temperature of the air was, at the time of making the experiment, 19°; the specific gravity of the water at 15° is 1·00598. The author made, first, a very carefully executed qualitative analysis of this water, and then a quantitative analysis, the results of which are quoted in duplicate—in one case, the carbonates have been calculated as neutral salts; in the other, they are calculated as anhydrous bicarbonates. For each analysis, moreover, the quantities are expressed in duplicate—that is to say, first, upon 1000 parts of water; next, in grains, at 7680 to the Prussian pound. Upon 1000 parts of water, the carbonic acid salts being calculated as anhydrous bicarbonates, there are contained in this liquid:—Sulphate of potassa, 0·09900; sulphate of soda, 0·14063; chloride of sodium, 1 14489; iodide of sodium, 0·00001; bromide of sodium, 0·00080; nitrate of soda, 0·00046; phosphate of alumina, Al_2O_3,PO_5, 0·00013; phosphate of soda, $2NaO,HO,PO_5$, 0·00018; bicarbonate of lithia, 0·00622; bicarbonate of soda, 2·57546; bicarbonate of ammonia, 0·00777; bicarbonate of baryta, 0·00008; bicarbonate of strontia, 0·00007; bicarbonate of lime, 0·55116; bicarbonate of magnesia, 1·63697; bicarbonate of protoxide of iron, 0·02949; bicarbonate of protoxide of manganese, 0·00043; silica, 0·02741. Total solid matters, 6·49816; free, that is to say, non-combined carbonic acid, 2·39334. The following substances are present in this water in quantities too small for determination by the balance:—Fluoride of calcium; borate of soda; organic matter, a mere trace; nitrogen, a mere trace. The Tönisstein chalybeate spring yields, on an average, a quantity of 9072 litres of water every twenty-four hours; this water, on being taken at the spring, is a quite clear, briskly-sparkling, refreshing liquid, yet at the same time ferreous to the taste. There escapes along with the water a considerable quantity of free carbonic acid gas, which amounts to some 6·840 litres during twenty-four hours. The temperature of the water of this spring was found to be 11·5°, while at the time this observation was made, the temperature of the air was 18°; the specific gravity of this water at 15° is 1·00270. 1000 parts of this water contain (the carbonates being calculated as bicarbonates):—Sulphate of potassa, 0·05444; chloride of potassium, 0·03575; chloride of sodium, 0.00911; nitrate of soda, 0·00102; phosphate of soda, 0·00040; phosphate of alumina, 0·00045; bicarbonate of lithia, 0·00048; bicarbonate of soda, 0·89325; bicarbonate of ammonia, 0·00410; bicarbonate of baryta, 0·00011; bicarbonate of strontia, 0·00156; bicarbonate of lime, 0·54075; bicarbonate of magnesia, 1·08154; bicarbonate of protoxide of iron, 0·05007; bicarbonate of protoxide of manganese, 0·00372; silica, 0·04107; entirely free, CO_2, 2·33600. Total, 5·05382. The following substances are present in unweighable quantities:—Fluoride of calcium, iodide and bromide of sodium, organic matter, borate of soda, and nitrogen; of all merely traces.

Analysis of the Lamscheid Mineral Water.—Dr. R. Fresenius.—This paper is not a sterile account of a chemical analysis, but contains, as introduction, a most interesting historical review of a very anciently-known and renowned mineral spring, situated on the so-called Hundstrück, at an elevation of 1100 feet above the level of the Rhine, taken at Boppardt, and on the great Chaussée, leading from the last-named place towards Simmern and Trier, at a distance of about 12 miles from the Rhine. The water bubbles up from a deep depression in Thonschiefer; the well is properly provided with masonry, to protect it from the entrance of extraneous water. The physical qualities of this water are the following:—Perfectly colourless, briskly sparkling, taste very refreshing, acidulous, somewhat ferruginous, and no smell. The well yields, in 24 hours, about 14,000 litres of water; its temperature is 10·2°, when the temperature of the air is at the same time 20°. The specific gravity of this water at 23·7° is 1.00147. The quantitative analysis of this water, its carbonic acid salts being calculated as bicarbonates, yields, for 1000 parts, the following results:—Sulphate of potassa, 0·004918; sulphate of soda, 0·006995; chloride of sodium, 0·005869; bicarbonate of soda, 0·070088; bicarbonate of lithia, 0·001279; bicarbonate of ammonia, 0·000795; bicarbonate of lime, 0·547639; bicarbonate of baryta, 0·000367; bicarbonate of strontia, 0·000074; bicarbonate of magnesia, 0·297382; bicarbonate of protoxide of iron, 0·071386; bicarbonate of protoxide of manganese, 0·0066771; phosphate of alumina, 0·000460; alumina combined with silica, 0·000034; silica, 0·034456; free, that is to say, entirely uncombined carbonic acid, 2·818499. Present in this water, but in too small quantity for estimation, are:—Nitrate of soda, iodide and bromide of sodium, organic matter, and nitrogen, all mere traces. The author quotes in this, as well as in the immediately preceding paper, a very interesting series of analyses of other mineral waters, for the sake of comparison. Space forbids us to abstract or quote these particulars here; suffice it to say that the Lamschied mineral water is a most excellent chalybeate, and quite equal to the celebrated chalybeate of Pyrmont.

Asparaginic and Glutaminic Acids.—Dr. Ritthausen.—Among the products of the decomposition by the action of strong sulphuric acid upon legumine and conglu-

tine, the latter substance being the proteine compound met with in almonds and lupines, the author discovered asparaginic and glutaminic acids, and, moreover, a substance the nature of which has not been further investigated. In this essay, the investigation of this subject, commenced some time ago, is fully described. Asparaginic acid exhibits a crystalline body, belonging, in that respect, to the rhombic system, soluble in water and alcohol, and consisting, in 100 parts, of:—C, 36·09; H, 5·26; N, 10·53; O, 48·12. Formula, $C_4H_7NO_4$. This acid, which yields, with the oxides of copper and silver, and also with baryta, well-defined salts, is converted, by the action of nitric acid, into malic acid, $C_4H_6O_5$. Glutaminic acid, $C_5H_9NO_4$, when pure, also exhibits crystals belonging to the tetrahedric rhombic system; soluble in water and alcohol; converted into glutanic acid, $C_5H_8O_6$, by the action of nitric acid.

Asparaginic Acid as a Product of the Decomposition of Animal Proteine Compounds.—Dr. Kreusler.—This author has undertaken, for animal proteine compounds, an investigation of a similar nature as Dr. Rittthausen has done for vegetable proteine substances. The writer of this paper has applied, for his researches, caseine from milk, albumen from eggs, and vitelline from the same. These substances were treated separately with a mixture of 3 parts of concentrated sulphuric acid and 6 parts of water to 1 part of substance; the boiling was continued for eight hours. After the necessary purifying process, and the use of oxide of copper to form salts, the author discovered, with perfect certainty, that asparaginic acid is formed in this instance; but glutaminic acid could not be detected. Animal horn, when treated with sulphuric acid, also yields asparaginic acid.

Analysis of the Iodine Containing Water from the Mineral Spring at Roy, near Freistadt, Silesia.—Dr. Redtenbacher.—10.000 parts of this water contain:—Chloride of sodium, 219·680; chloride of potassium, 2·062; chloride of calcium, 21 384; chloride of magnesium, 7·740; bromide of magnesium, 1·016; iodide of magnesium, 0·319; carbonate of magnesia, 1·832; carbonate of protoxide of iron, 0·505; free carbonic acid, 0·594; silica, 0·554; organic matter, 0·432; total of solid substances, 251·6. The iodine spring at Halle contains:—Bromide of magnesium, 0·584; iodide of magnesium, 0·426. The iodine spring at Lubatschowitz contains:—Bromide of magnesium, 0·116; iodide of sodium, 0·237. For both these last springs, the quantities quoted refer to 10,000 parts of water.

Annalen der Physik und Chemie, von Poggendorff, No. 9, 1869.

The following are original papers in this number:—

New Spectroscope and Contributions to the Spectrum Analysis of the Stars.—M. Zöllner.—The author describes what he calls a reversion spectroscope, and elucidates its mode of action by relating at length a series of observations made by him with this instrument.

Thermo-Chemical Researches.—M. Thomsen.—The basis of this lengthy essay is thus set forth:—Different acids, when neutralised with the same base, evolve unequal quantities of heat; when, therefore, any acid displaces another acid from its combination with that base, this decomposition will be accompanied either by an evolution of heat or by an absorption of heat, according to the greater or less heat of neutralisation possessed by the free acid or the acid of the salt. The quantity of heat thus evolved or absorbed affords a measure for the degree of decomposition.

Combinations of Alcohol and Water.—M. Mendelejeff.—This paper contains a review of almost every point worthy of notice bearing upon the history of the accurate determination of the density, contraction, and arcometrical assay of mixtures of water and alcohol at various temperatures. Another portion of this paper is an essay on the determination of the specific gravity of liquids; to this portion is added the description of a very ingeniously-contrived and neat apparatus, applied for the purpose of taking the specific gravity of liquids, illustrated by a woodcut.

Constant Capillarity of Fused Chemical Compounds.—M. Quincke.

Specific Heat of Air when Kept at a Constant Volume.—M. Witte.

Observations on the Chemical Constitution of Plagioklastic Felspar.—M. Tschermak.—The author does not explain the term *plagioklastic*, but he says the chemical composition of plagioklastic felspars is such that they exhibit isomorphous mixtures of two chemical compounds. [Our readers are reminded that felspar is a mineral of which there exists a great number of varieties; orthoklase, or potash felspar, is $KO,SiO_3+Al_2O_3,3SiO_3$.] The chemical composition of the varieties of this mineral oscillates between two extremes, viz:—Albite, $Na_2Al_2Si_6O_{16}$, in 100 parts:—Silica, 68·6; alumina, 19·6; soda, 11·8. Anorthite, $Ca_2Al_4Si_4O_{16}$, in 100 parts:—Silica, 4·30; alumina, 36·9; lime, 20·1. The author, who is an eminent mineralogist, enters into a lengthy discussion on the mineralogical characters of felspars, and sharply criticises the labours of some other mineralogists; it appears, however, that the chemical analysis of minerals of complicated composition is not a matter of mathematical certainty. As a proof, the author quotes two analyses of the self-same identical substance, made by two noted chemists, wherein the difference of silica amounts to +2·30 per cent; alumina, —1·95 per cent; lime, +0 53 per cent; soda, —1.44 per cent.

Labradorite from the Narodal.—M. vom Rath.

Elements of Terrestrial Magnetism for Gottingen, July 9, 1869, and the Secular Variations.—M. Cohlrausch.—At latitude 51° 31′, 8 N., longitude east of Greenwich 9° 56′, 6, the westerly declination of the magnetic needle was, on the above date, 14° 51′, 7; the inclination, 66° 47′, 4; horizontal intensity, 1·8412.

Reflection of Heat on the Surface of Fluor Spar and other Substances.—M. Magnus.—From this memoir we learn that the following substances reflect, at an angle of 45°, the undermentioned quantities of heat:—Silver, between 83 and 90 per cent; glass, between 6 and 14 per cent; rock salt, between 5 and 12 per cent; fluor spar, between 6 and 10 per cent.

This number contains some papers which have been translated from the *Proceedings of the Royal Society*.

Moniteur Scientifique, October, 15, 1869.

This number contains, among its original communications, the following:—

Manufacture of Alkaline Carbonates, and of Carbonate of Lead, and also other Carbonates, by means of a New Chemical Action.—M. Puissant.—When carbonate of baryta in finely-divided powder is suspended through water wherein, simultaneously, a proportional quantity of sulphate of soda is dissolved; and there is next passed through the liquid a current of carbonic acid, which is meanwhile brought to ebullition, double decomposition takes place, sulphate of baryta is formed, and carbonate of soda is found in the solution; this solution is filtered, and is employed, by means of a similar reaction, for the production of carbonate of lead. This is effected by the addition of sulphate of lead to this fluid, through which, while it is brought to ebullition, a current of carbonic acid is passed; in this manner, sulphate of soda is again formed, and carbonate of lead is deposited. It should, however, be understood that these reactions do not yield—(1) as regards carbonate of soda, that salt at a less cost than the process by which it is usually made; (2) that the carbonate of lead is neutral carbonate, and is not, therefore, possessed of the requisite covering quality of white lead, $3(PbO,CO_2),PbO,HO$, which is a basic carbonate of lead, which cannot even be made by passing into an aqueous solution of sub-acetate of lead, carbonic acid gas; unless, as is done by M. Ozouf,

at St. Denis, near Paris, the quantity of the gas is exactly regulated so as to produce a given quantity of white lead. The two following formulæ exhibit the reactions above alluded to:—

$$BaO,CO_2 + NaO,SO_3 = BaO,SO_3 + NaO,CO_2.$$
$$PbO,SO_3 + NaO,CO_2 = PbO,CO_2 + NaO,SO_3.$$

Quantitative Analysis of Raw Soda (Soda Ash) and Caustic Soda.—M. Jean.—After referring to the volumetrical methods devised by the late M. Gay-Lussac, and pointing out some inconveniences of this method, the author states that he proceeds as follows: —Take 4 grms. of the sample to be analysed, and dry completely at from 110° to 120°; the difference between the weight of the quantity originally taken and the weight after drying gives the quantity of water. Take 1 grm. of this dried material, place it in a glass tube, and pass a current of dry carbonic acid gas over the substance for about an hour; dry it again at 110°, to drive off any mechanically-adhering carbonic acid; place the substance upon a filter, and exhaust with tepid water (32°), until the wash water is no longer precipitated by chloride of barium. The filtrate is collected in a glass balloon with flat bottom, and chloride of barium is added to it. The liquid is left to settle, and, on having become quite clear, is drawn off from the precipitate, by means of a pipette, and the precipitate of carbonate of baryta is collected on a tared filter, washed with boiling water, dried, and weighed. If there happen to be sulphates present, the sulphuric acid is precipitated, along with the carbonate of baryta, as sulphate of that base, and the weighed carbonate of baryta is, therefore, washed with water acidulated with hydrochloric acid, again washed with warm water, and, after drying, weighed. In order to estimate the carbonate of soda, 1 grm. of the dried sample is taken, dissolved in water, precipitated with chloride of barium, the precipitate is collected on a tared filter, and, after having been washed and dried, there is deducted, from the weight found, the weight of the sulphate of baryta. The difference of the weight of the carbonates of baryta found by these two operations indicates the quantity of carbonate of baryta which, by calculation, has to be converted into caustic soda; the second assay gives the quantity of carbonate of soda. In order to estimate the sulphide of sodium contained, 1 grm. of the dried material is again taken; this quantity is dissolved in water, and estimated according to M. Gay-Lussac's method. Let us suppose that this assay has given a quantity of carbonate of soda equal to A, and that our previous operations gave us B of caustic soda and C of carbonate of soda; calculate the quantity of caustic soda, B, into C', as carbonate of soda—C' + C = C''', total quantity of carbonate of soda indicated by the gravimetrical assay. The difference between the quantity, A, of carbonate of soda indicated by the volumetrical method, and C''', that found by the gravimetrical method, indicates the quantity of carbonate of soda which has to be calculated as sulphuret of sodium.

Preparation of the Sulphuret of Sodium by a new Process.—M. Jean.—After referring to the difficulties attending upon the preparation of sulphuret of sodium, by igniting a mixture of sulphate of soda and carbonaceous matter, whereby a pure product can never be obtained, the author states that he has found the following process to yield very satisfactory results: 25 kilos. of dry sulphate of soda, 75 kilos. of sulphate of baryta, 10 kilos. of powdered charcoal, and 15 kilos. of powdered pit-coal, are intimately mixed and ignited in an ordinary soda furnace. From time to time, a small sample of the ignited mass is taken, and tested by being dissolved in water, filtered, and to the filtrate a drop of a solution of sulphate of soda is added. As soon as a precipitate of sulphate of baryta ensues, the operation is finished, and the ignited mass is at once transferred to iron vessels, which can be closed with a lid, so that access of air is excluded while the mass cools down; after cooling, the crude sulphuret is placed in wrought-iron tanks, and boiling water is added and ebullition kept up for some time; some sulphate of soda is added, in order to precipitate excess of sulphide of barium. After the liquid has become clear, it is drawn off by means of a syphon, and the solution evaporated to dryness. The sulphuret of sodium obtained by this process is quite free from any undecomposed sulphate, from sulphuret of iron, from silica, and from alumina. By this process, the fire-bricks of the furnace are not acted upon, and the ignited mass is in pulverulent, and not in fused state, and therefore no grinding is required. When, instead of sulphate of soda, sulphate of potassa is used, an excellent sulphide of potassium is obtained, which would be greatly in demand for the manufacture of ferrocyanide of potassium by Gélis's process, and for the artificial preparation of water impregnated with alkaline sulphides to be used for bathing purposes.

Purifying Bromide of Potassium.—Dr. Baudrimont.—The bromide of potassium is first qualitatively tested for the presence or absence of iodide of potassium; if that salt happen to be present, it is removed in the following manner:—About 10 grms. of the impure bromide are dissolved in a sufficient quantity of distilled water; a solution of bromine in water is then added in excess, this solution being preferable to bromine itself, as being more readily managed. The liquid is then heated to boiling, and kept so until no more vapours of iodine are given off. The liquid is next evaporated to dryness, in order to eliminate the excess of bromine. In this way a bromide of potassium is obtained free from iodide, but which may yet contain chloride of potassium.

Annales de Chimie et de Physique, October, 1869.

This number contains the continuation of an essay—

New Researches on Thermo-Chemistry.—M. Berthelot. This paper is divided into several sections, each bearing a separate title:—Decomposition of organic substances by heat; action of the electric spark upon marsh gas; union of nitrogen in free state with acetylen; direct synthesis of hydrocyanic acid; formation and decomposition of sulphide of carbon; chemical equilibrium between carbon, hydrogen, and oxygen; the spectra exhibited by some compound substances when exposed to gaseous mixtures in state of equilibrium; influence of pressure upon chemical equilibria, and especially on the reactions taking place between carbon and hydrogen.

Memoir upon the Determination of the Lengths of the Waves of the Metallic Spectrum Rays.—M. R. Thalén.

Second Memoir on Supersaturation.—M. Lecoq de Boisbaudran.—This paper is the first instalment of a second memoir of the subject named at the head. The author says—"I intend to divide this essay into two sections; in the first of these, I shall record the action of some isomorphous substances upon the supersaturated solutions of the sulphates of the oxides of iron, nickel, copper, cobalt, magnesia, and zinc; in the second portion of this essay will be found described the action of the same isomorphous substances upon supersaturated solutions of two of the above-named sulphates at the same time.

Revue Hebdomadaire de Chimie, October 7, 1869.

This number contains:—

Description of an Air-Pump with Free Plunger.—M. Deleuil.—There is added to this paper a well-executed woodcut. It appears that the vacuum which can be maintained by this air-pump is more perfect than has hitherto been obtained by any ordinary pump of the sort. From recipients of 250 litres capacity, the air can be withdrawn so as to leave only 10 m.m. pressure in a quarter of an hour. There is, with this machine, no need for the use of any oil to counteract friction. The piston (plunger) is double-acting, and it moves as easily at the beginning of the operation of pumping as at the end, with a very rarefied

air. The free space between the plunger and the body of the pump is only 1-50th of a m.m.

October 14, 1869.

This number contains:—

Use of Electric Alarums to Indicate a Certain Temperature.—MM. Besson and Knieder.—The authors have constructed a set of thermometers, through the tubes of which are soldered two small pieces of platinum wire, which are not in metallic contact, until the mercury just rises to the height at which the wires have been placed. Since the latter are in contact with conducting wires to a suitable galvanic apparatus, the instant the mercury makes metallic contact, an alarum is sounded; and this may, of course, by proper adjustment, be effected at any temperature, which, for some purpose or other, should not be exceeded. The instrument is intended for industrial use.

Glycerine Soap.—M. Heeren.—Take 100 parts of oleine of commerce, pour it either in a glass flask (when only a small quantity of soap is intended to be made, or in a cauldron for large quantities), add 314 parts of glycerine of 1·12 specific gravity, heat to 50°, and then add 56 parts of an aqueous solution of caustic potassa (sp. gr. 1·34), and stir the mixture well. The soap is readily and rapidly formed; but the liquid has to be kept at rest for twenty-four hours, and then exhibits a mass of the consistency of honey, in which state it remains. Filtration may be required, but is troublesome and slow.

Test for Albumen.—Dr. Méhu.—Take of crystallised carbolic acid, one part by weight; of commercial acetic acid, the same quantity; of alcohol at 90 per cent., two parts; mix, and keep in a bottle. This fluid is intended to detect albumen in urine; and, for that purpose, to 100 grms. of this liquid (urine) are added 2 c.c. of commercial nitric acid, and next, after thorough mixing, 10 c.c. of the carbolic acid solution. The reaction is stated to be very superior to the use of nitric acid alone.

Cosmos, October 16, 1869.

Liqueur de la Grande Chartreuse.—Dr. Chevalier.—According to this author, this celebrated liqueur, made at the Abbey of the name, near Grenoble, is composed of:—Essence of *melissa citrata*, 2 grms.; essence of hyssop, 2 grms.; essence of angelica root, 10 grms; essence of best mint, 20 grms.; essence of nutmeg, 2 grms.; essence of cloves, 2 grms.; and 2 litres of rectified spirits of wine, of best quality. The liquid is artificially coloured, either with turmeric or any other suitable material.

Les Mondes, October 14, 1869.

Biography of A. von Humboldt.—M. C. Bruhns.—The Director of the Royal Observatory at Berlin has stated that he intends to publish a scientific biography of von Humboldt, with the co-operation of a great number of German *savants*. The first portion of this work is entrusted to M. Lallemand, who has in his possession a large number of documents and manuscripts, never before published, relating to the late *savant's* life. The second portion of this work will consist of eight separate chapters, each treating of a peculiar science; and each chapter will be edited by the most eminent men in the department of science it treats of.

Removing Stains caused by Photographic Chemicals from the Hands.—M. Fortin.—Referring to the use of cyanide of potassium, and of iodide of potassium, and iodine for this purpose, the author says the first endangers health, and even imperils life; the second is very expensive. The author recommends, instead, to wash the hands with a concentrated solution of either sulphate or chloride of zinc, to which some acid is added at the same time. The deepest and blackest stains should be touched with metallic zinc, whereby the reduction of the oxide of silver or that of the gallate of iron is promoted, and all metallic stains adhering to, or penetrating in the skin removed. Since most of the salts of zinc are colourless, and soluble in water, the hands become soon quite clean. They should then be washed, first with pure water, and next with soap and water.

Preparation of Caustic Baryta for Industrial Purposes.—M. Nicklès.—Four operations are required—(1) Conversion of native sulphate of baryta into sulphide of barium is effected in a continuous manner, in a peculiarly-constructed furnace, the sulphate being previously mixed with a reducing substance; (2) the conversion of the sulphide of barium into hydrate of baryta by means of hydrated oxide of zinc; (3) dehydration of the hydrate of baryta by ignition along with saw-dust; (4) regeneration of the substance which has served for the desulphuration of the sulphide, and obtaining of sulphur.

Cultivation of Cotton in Southern France.—M. Croze-Mugnan.—The author states that, after having made a series of experiments for several years, he is convinced that the cultivation of the *Gossypium herbaceum* will be attended with excellent success in the warmer districts of the south of France.

New Theory of Gravitation.—M. Leray.—We only give the title of this paper, which is well worthy the notice of natural philosophers.

We learn from this paper that the Physical Society at Rotterdam, known as the Bataafsch Genootschap voor Natuur Schei en Werktiugkunde, has caused a number of medals to be struck to commemorate the hundredth anniversary of its existence. This medal, which is stated to be excellently well-made, bears upon the obverse the inscription, "Certos feret Experientia Fructus;" upon the reverse, "Societias Philosophiæ Experimentalis Batava Roterrodama Centesimum Natalem Celebrans. In Memoriam Stephani Hoogendijk, Fundatoris. MDCCLXIX—MDCCCLXIX." This Society has a large and very valuable collection of physical instruments, a fine library, and holds its meetings and lectures in the very extensive second-floor halls of the Royal Exchange at Rotterdam.

October 21, 1869.

New Process for Concentrating and Utilising the Sun's Rays.—M. Delaurier.—The author proposes, for this purpose, a truncated cone, open at both ends, and lined inside with polished silver, the sun's rays being admitted by the largest opening. Since the angle of reflection is equal to the angle of incidence, all direct, or reflected rays, will be united at the narrower end of the cone. It is clear that, the greater the length of the cone, the less the opening of its top may be, and the greater will be the concentration of heat. The author's paper, to which a woodcut is added, enters into a discussion on the advantage of this contrivance above the use of lenses and mirrors; and the author very enthusiastically surmises that the heat of the sun's rays may be so concentrated as to serve, instead of the combustion of fuel, for various purposes, especially in countries where, as in Algeria, the heat and splendour of the sun is more permanently felt.

Ancient and Modern Industry of the Chinese Empire.—Among the *accusés de reception*, we find, under the above heading, "d'Aprés des Notices Traduites," par M. Stanislas Julien, et accompagnées de notices industrielles et scientifiques, par M. Paul Champion, Preparateur du Chimie au Conservatoire des Arts et Métiers, Ancien Délégué de la Société d'Acclimatation en Chine et au Japon; 1 vol., large octavo, 254 pages, and 13 lithographic plates. This is an authentic work, having been faithfully translated from the Chinese language by the best scholars versed in that language in France, while M. Champion has been residing a long time in China, and describes what he has actually seen. The work embraces the following subjects:—Fuel, salt,

lime, sulphur, talc (magnesia minerals), nitrate of potassa (saltpetre), gunpowder, soda and potash, mineral pigments, alum, metals, vegetable colours and dye materials, vegetable wax (from trees), varnishes, oils. candles, ink, paper, printing, vegetable textile fibres, washing of garments, tobacco, papaver and opium, sugar, glucose, preservation of eggs, alimentary *régime* and wages, matches, amber, camphor, rearing of fish, magic lantern, boring of wells, silk, and some minor subjects. The entire work is full of extremely useful information, even for civilised Europe.

NOTICES OF BOOKS.

Field's Chromatography, or Treatise on Colours and Pigments as used by Artists. A new edition, re-written by Thomas W. Salter, F.C.S. London: Winsor and Newton, 38, Rathbone Place. pp. 435; 8vo.

We have, unfortunately, too many examples of the disastrous effects which ensue from the use of certain colours by artists who are unaware of their nature and durability. Many a grand and immortal work of art has suffered irretrievably from the fading of some paints, and the blackening of others, and the effects of damp and impure air upon others. Sometimes colours slowly react upon each other: sometimes bright lead colours pass, in the course of years, into the dingiest of greys, ultimately becoming almost metallically black from the sulphur of the air by which they are surrounded. Now, with all this in view, the appointment of a Lecturer on chemistry to the Royal Academy of Arts has been more than once seriously discussed, and we may hope that, sooner or later, will be carried into effect. In the same direction, and tending to remove such like conflictions of chemical with artistic lore, is Field's, "Chromatography;" and we are happy to welcome a new and revised edition of it. Fortunately its reviser, Mr. Salter, is a chemist; so that artists have already within their grasp a certain application of chemical knowledge to the usages of their craft.

In the prefaee to this new edition, Mr. Salter informs us that the work has been entirely revised and re-written, "the notices of colours have been considerably extended, their chemical and artistic properties more fully dilated on, and many new pigments of the utmost importance described." Mr. William Winsor was engaged upon the revision of this work at the time of his death, and his *collaborateur* regrets that the intimate knowledge of colours which Mr. Winsor possessed can no longer be applied to the purposes of the revision.

The "Chromatography" is divided into three parts—Part I. "On Colours and Colouring;" Part II. "On Colours and Pigments generally;" Part III. "On Colours and Pigments individually."

In the first chapter, an infinitely too brief history of the prominent phases in painting is given, and allusion is made to the early works on the Egyptians and Greeks. There are, it is asserted, in reality, but three schools of painting—the *Material*, the *Sensible*, and the *Intellectual*. "Modern art, as founded upon the *intellectual* school of the ancient Greeks, became grand, scientific, and severe in the practice of Michael Angelo and Leonardo de Vinci; graceful, beautiful, and expressive in Raphael, Correggio, Domenichino, and Guido; and, aiming at *sensible* perfection, it attained harmony of colouring and effect in the works of Titian and Tintoret; but it sunk into grossness and sensuality while perfecting itself *materially* among the Flemish and Dutch." This is indeed a sweeping survey, so sweeping that no mention is made of the French or Spanish schools. We would not ask it for ourselves, for it is so recently that anything like an English school of painting—and that a mongrel and a bastard offspring—has arisen, that we can well make no demands for recognition; but surely, in the above statement, the name of Fra Angelico de Fiesole should come in between Raphael and Correggio nay, we know not whether he should not be placed at the head of those painters who brought art to its culminating point in regard to the graceful, the beautiful, and the divine. What shall we say to those glorious angels, with wings sprinkled with golden stars, who are ascending jubilantly upon the purple clouds which curl at their feet? Or what shall we say to the serene and infinitely majestic and calm S. John, seated upon the outspread wings of an eagle? The art of to-day is as far behind the art of that day as the science of to-day is in advance of the science of that day. We always think that picture must have reference to Fra Angelico in which we see a monk who, seated in front of his painting, has fallen asleep over his work, while an angel, taking the brush from his fingers, continues that which he has left undone.

Passing on now to the third chapter, which commences Part II., we find some very useful definitions; for example, "By mixing his colours with white, the artist obtains his *tints*. By mixing colours with colours, he produces compound colours, or hues; and, by mixing colours or tints with black, he gets *shades*." Colours themselves are divided into five classes; the Neutral, the Primary, the Secondary, the Tertiary, and the Semi-Neutral. Neutral colours are *black*, *white*, and *grey*. Primary colours are *yellow*, *red*, and *blue*. Secondary colours are *orange*, *green*, and *purple*. Tertiary colours are *citrine*, *russet*, and *olive*. Semi-neutral colours comprehend all the combinations of primary, secondary, and tertiary colours, with the neutral black.

In regard to the "durability and evanescence of pigments," we have a good deal of useful information in chapter 4. The organic colours are most easily affected by light and air; compounds of lead, mercury, and copper by air containing sulphuretted hydrogen. Many colours are altered by the action of lead pigments, and others, again, by ferruginous pigments; finally, the vehicles and varnishes with which colours are mixed often act deleteriously upon the colours.

No less than seven-eighths of the work are devoted to colours and pigments individually considered; and we have here a long list of colours, with an account of their composition and general qualities: let us take the following as an example of the mode of description here employed:—"Burnt carmine is the carmine of cochineal partially charred, until it resembles, in colour, the purple of gold, for which, in miniature and water-painting, it is substituted. It is a magnificent reddish purple, of extreme richness and depth, eligible in flower painting and the shadows of drapery. As it is generally impossible, however, to alter the nature of a pigment by merely changing its colour, burnt carmine is scarcely more permanent than the carmine from which it is produced. If used, therefore, it should be in a body, and not in thin washes, or as a glaze. Durable pigments are admissible in any form; but semi-stable pigments (gamboge excepted) should only be employed in body."

We are glad to notice that descriptions of new pigments have been introduced; thus we have aureolin, thallium red, tungstate of baryta, viridian, brun de mars, indium yellow, and molybdenum green.

The "Chromatography" cannot but prove most valuable to all who are interested in art; and we cordially recommend it even to that dignified and austere body which dictates the art taste of the kingdom.

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The Chemical Manufacturer's Plant, as Supplied by the St. Helen's Foundry, Lancashire."

This is an illustrated catalogue of various vessels employed in some of the chemical manufactures, notably in the two greater industries, sulphuric acid and soda. Thus we have pyrites' burner frames, nitre pots, decomposing pans, black ash vats, crystallising pans, &c. Some of the decomposing pans described have a thickness of no less than 7 inches at the bottom; the charge of salt is from 5 to 18 cwts.; and the amount of salt-cake decomposed in a pot varies from 1000 to 2700 tons. The "black ash revolving furnace" is also figured, and appears to be replacing the old hand-furnace in Lancashire and elsewhere.

On Fresh Meat Preservation. By John Gamgee. London: Robert Hardwicke. 1869.

We have, in a pamphlet bearing the above title, an address delivered by Mr. Gamgee before the Board of Agriculture of Amherst (Massachusetts), on a mode of preserving meats for an indefinite time. After many trials, the process which was found to act best was the exhaustion of air from the vessels containing the meat to be preserved, and the introduction of various vapours. Among other substances, the following were tried: Ozone, chloroform, ether, tetrachloride of carbon, bichloride of methylene, carbolic acid, chlorine, hydrochloric acid, and binoxide of nitrogen; but these were ultimately abandoned for sulphurous acid, introduced into the preserving vessel condensed in the pores of charcoal. "I believe," writes Mr. Gamgee, "that charcoal, saturated with sixty-five times its volume of sulphurous acid, will remain, to the end of days, the cheapest, most manageable, and most universally employed antiseptic that the meat preserver can use. It is, perhaps, bold to predict, that which I do with the greatest confidence, that charcoal and sulphurous acid will, in a few years' time, to a great extent, supersede the use of salt." For various reasons, however, sulphurous acid could not be used alone; and the experiments of Hoppe Seyler suggested the simultaneous employment of carbonic oxide, as it was found to preserve the colour of the meat and to expel the oxygen from the tissues; it also acted as a neutral gas to surround the meat in air-tight vessels in place of atmospheric air. The meat to be preserved was placed in a vessel capable of being exhausted by an air-pump; lumps of charcoal saturated with sulphurous acid were then added, and the vessel was exhausted as completely as possible; carbonic oxide was then introduced until the normal atmospheric pressure prevailed within the preserving vessel. Meat thus preserved was found to keep perfectly, not alone in closed cans, but in open vessels, and it could not be distinguished, as regards taste, from recently killed meat. Of course the chief obstacle to the adoption of the process is the expensive nature of the apparatus, and attempts have been made to displace the oxygen from the neighbourhood of the meat, by driving carbonic acid through the preserving vessel by means of a fan; it is obvious, however, that the tissues would still remain charged with oxygen. Whatever may be the value of this process on the large scale, there can be no doubt that few inventions could, at the present time, be of greater value to the human race at large than one which would secure the utilisation, as food, of the thousands of tons of meat which are now wasted in Australia and Texas, and the Argentine Republic. To allow myriads of oxen to attain maturity, and to destroy them for the sake of their skins alone, seems an act comparable to that of the Roman Emperor who caused several hundred flamingoes to be destroyed that he might be provided with a dish of their tongues.

Cleveland and its Metropolis. September 21st, 1869. Middlesborough-on-Tees: Printed at the *Gazette* Steam Printing Works. 1869.

We have received this neat little pamphlet accompanied by a very good map of the district. Its pages contain a very large amount of diversified information, written and compiled with care, and published especially for the information of those members of the Steel and Iron Institute, who, on the occasion of their first provincial meeting at Middlesborough, repair thither and are strangers to the district. We have an historical and archæological review of Cleveland, next a brief but very comprehensive account of the geology of this part of the county of York, followed by a brief history and description of the municipal and parliamentary borough of Middlesborough. The last two pages are devoted to the quotation of analyses of ironstone of this district, coke, best Durham, Weardale limestone, Forcett limestone, pig iron, No. 1, Acklam Ironworks, and an analysis of grey-coloured slag. The authors of these analyses are Messrs. Crossley and Pattinson. At the end of the work a short description is given of the Acklam Ironworks, owned by Messrs. Stevenson, Jaques, and Co. The map which has been sent along with this pamphlet, has been published by Messrs. Gillan, Schmitz, and Co., iron merchants and shipowners, Middlesborough and Glasgow, is excellently executed, and deserves creditable notice, especially since this kind of very useful publications, showing as it does the blast furnaces, rolling mills, etc., is too much neglected in this country. Maps indicating the different local industries of a county are very useful, and the getting up and publishing of them deserve every encouragement.

Elements of Chemistry: Theoretical and Practical. By William Allen Miller, M.D., LL.D., &c. Part III. *Organic Chemistry.* Fourth edition, with additions. Longmans. 1869. 976 pp.

Dr. Miller's works on chemistry have become so thoroughly classical in chemical literature, that, at first sight, it may appear almost unnecessary to notice a new edition of one of them; it will be well, however, as the work has been revised and a good deal augmented, to point out the more important changes and afterwards to give a brief account of the general arrangement and classification of the subject matter.

The principal changes in this edition consist in the uniform adoption of the new notation, together with the system of nomenclature first introduced by Berzelius, then abandoned, and now revived by Wurtz and Cannizzarro, and generally adopted in the chemical world. The metrical system of weights and measures and the centigrade thermometric scale have also, in this edition, been placed side by side with our own scales and measures.

The entire work is divided into fourteen chapters, which gives an average of about sixty-eight pages to each chapter, and there is a further sub-division of each chapter into "parts" and numbered paragraphs. The first and introductory chapter treats of "Organic Analysis, Classification of Organic Bodies, Metamorphosis, Synthesis." Now it has been a good deal contested whether we should not abolish the term "Organic Chemistry," since the old distinction has fallen to the ground, and more than a thousand substances once believed to be formed and capable of formation only in the organisms of plants and animals, have been synthetically prepared in the laboratory of the chemist. Hence, at the outset of this work, we find a statement of the difference between *organic compounds and organised bodies*, the former of which can, in many instances, be prepared synthetically, while the latter are "the result of the action of living bodies upon inanimate matter," and cannot be prepared synthetically. Sugar, oxalic acid, and urea belong to the class of "organic compounds," while muscular tissue and ligneous fibre belong to the class of "organised bodies." As to the line of demarkation between inorganic and organic products, this does not exist, still, as Dr. Miller observes, "it is convenient to sub-divide chemical compounds into organic and inorganic; since those derived from the inorganic world, from the greater simplicity of their composition, afford to the student the most favourable instances for examining the fundamental laws of chemical combination before he proceeds to the investigation of the more complicated products obtained from the operations of the living plant or animal."

The account of the analysis of organic bodies is followed by remarks on the classification of organic compounds, in the course of which the theory of compound radicles and of the Polyad Elements are discussed.

Chapter 2 treats of "The Saccharine or Amylaceous Group: Different varieties of Fermentation," and is divided into four parts. The first is devoted to an account of the different kinds of sugar, and in it will be found (pp. 110 and 111) an extremely useful table giving a list of the various sugars, together with the principal properties and distinguishing characteristics of each. The table commences with

[English Edition, Vol. XX., No. 515, pages 176, 177; No. 518, page 210.

cane sugar, and ends with pinite, $C_6H_{12}O_5$, which has been extracted by Berthelot from *Pinus Lambertiana;* it is a readily soluble substance, with a very sweet taste, not fermentable, incapable of producing mucic acid with nitric acid, and producing right-handed rotation of a ray of polarised light. Part 2 treats of the varieties of starch and gum, and contains an admirable statement of the theory of the action of ferments. Part 3, "Cellulin and Woody Fibre," includes an account of coal and other combustible materials, and useful tables of the analyses of coals. Part 4, "On Fermentation," treats of alcoholic, lactic, and viscous fermentation.

Chapter 3, "The Monatomic and Diatomic Alcohols and Ethers," is divided into seven parts, and extends over 120 pages. It commences with an account of the Monatomic alcohols, passing to the ethers, and to the action of chlorine on ethers and alcohols. Part 5 treats of the "Metallic Derivatives of the alcohols," commencing with zinc-ethyl; then kakodyle, AsC_2H_6, which was the first substance of this class, and was obtained by Bunsen; the name is unfortunate, especially if we are to call it kakodylide of kakodyle—$(AsC_2H_6)_2$ or Kd_2—; we certainly prefer the name *arseniodimethyl, or arsendimethyl.* There are hundreds of compounds in chemistry which might be called kakodyl with as much reason as arsendimethyl. The practice of naming a substance from one of many characteristics which it has in common with other substances cannot be too much reprobated or too soon abandoned.

Chapter 4 treats of the triatomic alcohols; "the Fats and Fixed Oils and Glycerine." Chapter 5 of the "Products of Oxidation of the Alcohols—Acids." The third part is devoted to the fatty acids, and the fourth to certain other vegetable acids, where will be found a detailed description of the modifications of tartaric acid, and mention of the remarkable series of acids obtained by Löwig by treating oxalic ether with sodium amalgam.

Chapter 6, "The Amides and Organic Bases," contains a very detailed account of the organic bases, commencing with the the volatile bases which do not contain oxygen, and first of analine. Among the natural bases we find the cinchona alkaloids, cinchonia, cinchonidine, and cinchonicine; the alkaloids of opium, of the peppers, of the *Strychnos* tribe, and, of tea, coffee, and chocolate. Chapter 7, "Of Essential Oils and Resins," contains Part 1 of Essences, 2 of Resins, 3 of Gluco-ides. Chapter 8 "Of Colouring Matters," contains a list of colouring matters obtained from lichens, and on page 665 we find an "Assay of Lichens for Colouring Matter." The most striking peculiarity of the lichen acids would appear to be their power of etherifying alcohol.

Chapter 9 contains an account of "Products of Destructive Distillation." Chapter 10, "Compounds of Cyanogen; Bases of Animal Origin; Uric Acid and its Derivatives." The cyanides are divided into two classes—"Cyanides which do not contain Electro-negative Metallic Cyanides," among which are the zincic, plumbic, and palladious cyanides, and into "Cyanides which contain Electro-negative Metallic Cyanides," among which are the ferro- and ferricyanides, the nitroprussides, cobalti-cyanides, and iridicyanides. Chapter 11, "Albumenoid and Gelatigeneous principles." Chapter 12, "Chemical Properties of some of the Solids and Fluids of Animal Origin;" and Chapter 13, "On the Nutrition of Plants and Animals." The two last chapters, which, together, extend over nearly 100 pages, will be of special use to medical students and those who devote themselves more particularly to physiological chemistry. Herein are discussed the chemical nature of—(1) the solid constituents of animals—bones, shells, horny matter, fibrous and elastic tissues, and of the components of the brain; (2) "Some Important Animal Fluids"—blood, chyle, lymph, milk, &c.; (3) the liquids concerned in digestion—saliva, gastric juice, bile, with a table of bile products; (4) excrementitious products—urine, excretin, and pus.

The fourteenth and final chapter is devoted to a discussion of "Atomic Volumes, and the Law of Boiling Points," and contains a number of useful and important tables. The first of these (pp. 921-924) shows the density of a number of compound gases and vapours, and is arranged in the following order:—Name of compound, constituents, formulæ, density, calculated when H=1 and when Air=1, and observed in the latter case, and the authority. Next a table (p. 927) of the atomic volumes of elementary bodies; then the atomic volumes of certain oxides, sulphates, chromates, tungstates, carbonates, and nitrates, and of liquids of analogous composition. The remainder of the chapter is devoted to Kopp's law of boiling points. The fundamental proposition of this law is, as is well known, that for every addition of CH_2 in the empirical formula of compounds of ethyl and methyl, a rise of temperature of about 20° C. takes place in the boiling point; it has further been observed, as a general result of observation, "that the boiling point of a normal acid is 63° C. higher than that of its methylic ether, 44° C. higher than that of its ethylic ether, and 13° C. lower than than that of its amylic ether the boiling point of an alcohol of the form $C^nH_{2n}+_2O$; is about 40° C. lower than that of its corresponding acid $C^nH_{2n}O_2$; a compound ether of the form $(C_nH_{2^n}+_1C^nH_{2n}-_1O_2)$ boils at about 82° C. below the acid $(C_nH_{2n}O_2)$ which is isomeric with it." It is notorious, however, that very considerable discrepancies have been observed as regards the accuracy of Kopp's law, whether arising from inaccuracy of observation or from a defect in the law remains to be proved. Kopp has well observed in regard to these discrepancies "That it must not be assumed that the boiling points of liquids, when compared at *any* given pressure, will always exhibit the same differences as they do when compared at the average pressue of 30 inches (760 m.m.) of mercury. It does not follow, for instance, though the boiling point of ether is 79·5° below that of alcohol under a pressure of 30 inches, that under a pressure of 15 inches, the difference between these boiling points should still be 79·5°; since it is well known that what is called Dalton's law, viz., 'that all liquids at equal distances from their boiling point emit vapours of equal tension' is not correct."

The excellence of Dr. Miller's "Organic Chemistry" is so well recognised that it does not require one word of praise here. The very fact of its having reached a fourth edition (which is the fate of few large chemical works in this country), speaks for itself. Since Dr. Miller is constantly engaged in the teaching and the practice of chemistry, we are insured in his works the very newest matter, whether of theory or experiment. Thus we notice, in this edition, an account of the very recent researches of Messrs. Matthiesson and Wright on morphia and codeia. The constant reference to researches is of especial value, and if the year were more often added to the number of the volume and page of the work quoted, would be of still greater service. We regret to notice a somewhat large list of *errata* for a fourth edition, for although the corrections may be made once for all in ink, a work is always somewhat disfigured thereby. The use of a variety of types is now becoming more or less general in scientific works, especially on the continent, and when this can be done it certainly greatly facilitates reference; the broad thick letters and numbers are especially useful for the heads of paragraphs, while salts may be advantageously printed in small capitals, or with some other distinctive type characteristic: if in a later edition of the work we are considering this could be done, we think it could be consulted with greater readiness. We are almost surprised to find that Dr. Miller, whom we have been wont to account one of the more conservative chemists, has not only fully adopted the changes in the atomic weights and in the formulation of compounds, but has also introduced the changed names of substances, or, at least, one set of changed names. Thus it surprises us to find him speaking of "Plumbic Chloride," "Zincic Oxide," "Sodic Sulphate," and "Palladious Cyanide." The adoption of these terms by so eminent an authority will do much towards making them universal in the chemical liter-

ature of this country. We cannot help thinking sometimes, when we notice the extent and the variation of these changes, of the future of chemistry. If the science progresses in the next quarter of a century as much as it has in the last quarter (and there seems no reason to doubt that it will), there must of necessity be great and portentous changes. We cannot yet treat the facts of chemistry in a dogmatic and final manner. We cannot lay down such propositions as did Euclid of geometry; there is no absoluteness at present in our science; there is nothing of which we can speak with the same precision as we speak of the relation of the circumference of a circle to its diameter. And so long as this is the case some are of opinion that any changes tending to produce complexity should be avoided until their adoption has become, by the general consent of the chemical world both at home and abroad, a matter of absolute necessity.

Exercises in Practical Chemistry. By A. Vernon Harcourt, M.A., F.R.S., and H. G. Madan, M.A. Series I., *Qualitative Exercises.* Oxford: Clarendon Press. 1869. 335 pages.

This joint work of Messrs. Harcourt and Madan is the last volume which has appeared in the very useful "Clarendon Press Series" of Messrs. Macmillan and Co.; and it forms the first half of a work which is to include quantitative analysis. The object of the work "is to furnish a systematic course of study to those who are beginning to learn chemistry practically;" and, with this in view, the authors have detailed, with much care and precision, the nature of, and the mode of manipulation with, all the more general apparatus, and have given in the Appendix suggestions for the construction of the simpler apparatus.

At the outset, we notice, under the head of "Memoranda," a series of ten aphorisms, embodying, in very terse language, rules for the attainment of the exactness and precision of action, and of the attitude of mind which must accompany chemical work. Such are:—

1. "Be orderly and neat in manipulation. Cleanliness stands at the head of the chemist's scale of virtues. All messes must be cleared away with the zeal of a sanitary inspector.

2. "Do not begin work in a hurry.

3. "Be economical of materials.

6. "Do not think merely of what will *do*, but what is *best*, of the means at your disposal.

10. "Finally, do not look upon chemistry as a mere amusement—as a means of getting up a few explosions, creating a few unsavoury smells, producing a few striking changes of colour. Chemistry is worthy of better treatment. It is no longer a 'black art,' but a refined science, and should be thoughtfully and reverently studied."

After the "memoranda," we have a list of the apparatus, and of the substances required for the work described. The illustrations of apparatus are, for the most part, drawn on the block direct from photographs taken by one of the authors. We do not notice the introduction of any new or modified form of apparatus; and that which is described is (as it should be) of the very simplest and cheapest description. Part I. is devoted to "Experiments on the Preparation and Properties of Substances," and this is commenced by an account of different operations, such as—"Fusion and Granulation;" "Glass-working;" "Solution, Evaporation, and Crystallisation;" Precipitation and Filtration;" "Distillation;" "Use of the Pneumatic Trough." Each of these is described with the utmost detail; for instance, more than two pages are devoted to the method of boring a cork, and more than three to the use of the pneumatic trough.

Section 2 treats of the "Preparation and Examination of Gases;" and each *exercise* is conveniently headed by a list of the apparatus and materials required for the preparation of the particular gas about to be described, even down to "cedar matches," and "a jug of water." We do not think that the list of experiments is at all sufficient; nor does there seem to be any effort to introduce new or modified effects. In the experiments in connection with oxygen, the burning of sodium in that gas is not mentioned; yet this is surely an experiment of the utmost importance, for it behoves the teacher to show the inappropriateness of the name oxygen, inasmuch as, by its combination with substances, are produced, not alone acid compounds, but also some which are neutral and alkaline. Again, the burning of naphthaline in oxygen is a very notable experiment; as, also, the burning of thallium, zinc, and aluminium. Hydrogen, nitrogen, and the protoxide and dioxide of nitrogen are next described; and an account of the collection of gases by displacement heralds "Carbon Dioxide," in the account of which we are glad to notice the capital experiment of burning magnesium in a bottle of that gas, which is a far easier plan than the old arrangement of a bulb-tube and red-hot potassium. To separate the black flakes of carbon from the white flakes of magnesia, the bottle is to be rinsed out, and hydrochloric acid added to dissolve the magnesia. In order, follow—"Carbon Protoxide," "Ammonia," "Hydrogen Chloride," "Chlorine," "Ethylene," and "Sulphur Dioxide." Remembering to how large an extent the work before us will be used in schools, and the usual recklessness of boys, we think it behoves the authors, in the next edition, to add special precautions in regard to explosive substances. For instance, we do not think that nearly enough has been said about the danger of exploding ethylene with oxygen gas, from the careless management of which experiment a really serious accident might without difficulty arise.

Section 3 treats of the "Preparation of Reagents used in the Laboratory." The preparation of solutions of hydrogen sulphide, of chlorine, of chloride of tin, and of "Hydrogen and Silicon Fluoride," is here described. Then follows an extremely useful chapter on the "Preparation of Normal Solutions of Reagents," in which no less than thirty-seven solutions are described.

Section 4 treats of "Experiments with the Mouth Blowpipe;" and Part 1 is concluded by Section 5, wherein is detailed an "Examination of the Properties of the Principal Radicles and their Salts." Nearly one-third of the book is devoted to this subject; and explicit accounts are given of the properties and mode of examination of all the substances in most general use in the laboratory. The following may be taken as an example:—

"Place a bit of magnesium-ribbon, about 25 c.m. in length, in a test-tube, and pour on it some dilute hydrogen sulphate. Hydrogen gas will be evolved with effervescence, and the metal will gradually dissolve. When the action has ceased, pour off the liquid into a small porcelain dish, and evaporate it down until it begins to crystallise. Long prismatic crystals of magnesium sulphate (Epsom salts) will be deposited in abundance as the solution cools; these should be re-dissolved in about 20 c.c. of water, and separate portions of the solution tested as follows:—

(*a*) "To a portion, add a drop or two of solution of ammonium sulphide. No precipitate will be formed, since magnesium sulphide, unlike zinc sulphide, is soluble in water."

The other usual tests follow—sodium carbonate, ammonium carbonate, ammonia and ammonium chloride, and the blowpipe test with cobalt.

Part 2 treats of the "Qualitative Analysis of Single Salts," and is divided into six sections, of which the first explains the general nature of the analytical course; the second, the "Preliminary Examination of the Substance;" the third, the "Examination of the Solution of a Single Salt for a Metal;" the fourth, the "Examination of the Solution of a Single Salt for Non-Metallic Radicle;" the fifth, the "Examination of an Insoluble Substance;" and the last, an "Example of the Analysis of a Single Salt." A general grouping of substances is given in the first section, together with a table showing the distribution of the principal metals into groups for the purposes of separation. The preliminary examination is discussed under thirty-one separate heads, and is very clear and precise. The

whole subject of Part 2 is divided into seventy-four minor heads, and these are distinguished by bold and black figures placed near the margin. The extent to which printers' type can indicate a desired difference by its own difference of form is surely well shown in this work; for, in a single page, we observe no less than *nine* different kinds of type.

The work is concluded by six short appendices, whereof the first contains "Suggestions for the Construction of Chemical Apparatus;" and here we find such proposals as the conversion of a biscuit-tin into a pneumatic trough, of a door-handle into an Argand burner, and of a tobacco-pipe into a deflagrating spoon. Without doubt, it may be well sometimes for the student to exercise his ingenuity in this way; but, when we remember the extreme cheapness of all the more ordinary chemical apparatus, we do think a great deal of time is often wasted in the attempt to construct that which, after all, is but a clumsy and short-lived piece of apparatus. Appendix B discusses the recovery of gold, platinum, and silver from their residues. Appendix C contains a very useful table of the solubility of a number of salts, on the authority of Storer's "Dictionary of Solubilities." Appendix D contains "Tables of Weights and Measures." Appendix E treats of "Thermometric Scales." And, finally, Appendix F discusses the nature of chemical symbols, which are very sparingly used throughout the work. The index is short, but is, perhaps, sufficiently long for a book which, to a certain extent, constitutes its own index.

Regarding the book as a whole, it may be said to contain a large and varied amount of information; the matter is condensed as much as possible, although considerable minuteness of detail is frequently apparent. We confess that the arrangement often appears to us to be complex, and we do not grasp the design which the authors had in view in certain of their modes of arrangement. Indeed, every new work on Chemistry appears to us more complex than that which preceded it; Bloxam's "Laboratory Practice" is surely a less complex (but in all fairness, be it remembered, also a less comprehensive) work than that of Messrs. Harcourt and Madan; while, to our mind, the least complex work of all is "Bowman's "Practical Chemistry." It will be borne in mind that we speak here solely of arrangement of matter and simplicity of style. Perhaps we are too conservative in all this; perhaps we like too much *stare super antiquas vias*, but, truly, we think that much of the chemical literature of the period is characterised by unnecessary complexity and obscurity. At the same time it is undeniable that Chemistry itself is advancing in the same direction, and so long as this continues to be the case, we cannot expect to have a different literature. The importance of an extreme simplicity in the mode of teaching a new and difficult science to boys cannot be exaggerated. A boy with some glimmer of a taste for science will, if he meet with a rebuff at the outset, probably abandon the study altogether. The questions which boys ask after hearing a lecture indicate how they often unwittingly create difficulties, and in the abstruse branches of analysis these difficulties must more frequently arise. Let it be remembered, however, that Messrs. Harcourt and Madan have had much experience in science teaching, and we may feel very sure that they have embodied the sum and substance of that experience in the work before us. They are both well qualified to write on the subject, and they have done justice to it. Their work appears very opportunely, for now, more than ever, is the establishment of school laboratories and science classes receiving the attention of all who are interested in the educational progress of this country, and we are well assured that the work we have been considering will be much used both in the higher classes of our schools and in our universities.

CORRESPONDENCE.

Ink.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xx., p. 155, *Amer. Repr. Dec.*, 1869, *page* 356), you give M. Voigt's recipe for "a very black and very cheap ink." The objections to it seem to me to be these—(1) It involves a number of unnecessarily troublesome processes; (2) it requires the use of sulphate of copper, which leads to the deposit of copper on steel pens, and so makes them useless; (3) it prescribes corrosive sublimate, which is not good for little boys, who will suck their pens; (4) it recommends logwood, which gives a brownish tone to ink.

For any one who wishes to make his own writing-ink, I do not know an easier or better method than that adopted by the late Professor Daniell, of King's College. He put into a stoneware jar 1 gallon of soft water, ¾ lb. of bruised nut-galls, and next day 6 ozs. of green vitriol, 6 ozs. of gum-arabic, and 4 or 5 drops of kreosote. The bottle was then corked, and left in a corner of the room for two or three weeks, so that, once in two days, or so, it might remind the owner that it wanted a good shaking. After this, it was left a few days, and then the clear liquor was decanted off for use. This formed a very black, a very cheap, and, what is more, a very durable ink.

I have letters from Professor Daniell written with such ink a quarter of a century ago, and from Snow Harris (who used the same ink), of the same date, and they form a good written character of this useful black servant.—I am, &c.,

C. T.

September 26th, 1869.

Blowpipe Chemistry.

To the Editor of the Chemical News.

Sir,—In my letter on the 17th of June, to your address, I state as follows:—"I reflected, however, that borax, being a compound salt, could scarcely be expected to give uniform results chemically, either as regards crystallisation or any other operation." The same reflection, together with a strong wish to obtain trustworthy reactions by the blowpipe through which the alkalies and alkaline earths could be detected, led me to try the colouration of Co solution with pure boracic acid, adding the alkali or earth to be experimented upon by traces at a time. I succeeded beyond my utmost expectation; the CoO, indeed, was scarcely at all dissolved in the pure BO_3; but I observed with my magnifying-glass spots of deep red-violet colour upon the cooler part of the platinum wire, which promised good results; and I found that, upon the addition of a trace of potash or soda, taken up on the hot bead, the CoO quickly dissolved, producing, in both cases, a pretty but light pink colour. I then generally (for I have made hundreds of experiments, with the detail of which I will not fatigue you) took upon the bead one more drop of Co solution, which deepened the pink colour, and showed a fine mauve-blue while hot. By the gradual addition of soda ($NaOCO_2$) to this, both the hot and cold beads were deepened in their tints, the former showing, for a moment, a deep blue-violet, and the latter remaining a splendid violet or purple colour. At last, the bead thus treated remains blue, both while hot and cold, and the amount of Na taken to effect this shows, I presume, pretty exactly that contained in borax.

The boracic acid cobaltine bead, treated in a similar way with potash, shows the same series of colours, but the potash blue is deeper, and has a dark violet tinge in it, which the soda blue has not, except when held against the flame of the lamp. On the addition of soda to a potash cobaltoboracic acid bead, this violet-blue is not changed, but even deepened; and the addition of potash to soda in a similar bead has a like effect. The addition of carbonate of lime to a boracic acid bead, with a drop of Co solution, produces a mauve-blue, opaque bead, magnesia a lavender-blue, opaque bead, both going through the gradations of pink, &c.

Fluor spar produces a clear bead; after a time, mauve-blue; so that the fluorine assists the boracic acid to dissolve

the lime. Magnesia, assisted by a trace of potash or soda, may, by gradual addition, be made to go through the usual gradations of pink, &c., in a clear bead, until a mauve-blue is attained.

It will be proper here to detail two experiments showing the quantity of potash and soda taken respectively to satisfy an equal quantity of BO_3.

(1) "Measured very carefully half of 5 measures of BO_3, forming a bead about three-fourths the diameter of glass tube. Filled five measures with $NaOCO_2$; took a trace on hot bead, and added drop of Co solution; light pink, no undissolved Co discernable. Another drop Co solution; mauve hot, amethyst colour cold. Another trace Na; blue-mauve hot, dark purple cold. Trace more Na; lime-blue hot, blue-purple cold. Trace Na; deep mauve-blue hot, deep purple-blue cold. More Na; a little darker colours than before. More Na; mauve-blue. More Na; held against a bead of cobaltine borax, the blue still appeared mauve. More Na; not borax-blue yet. More Na; cobalt borax-blue. It took three-fourths of 5 measures (75 milligrammes); but, as it was a hydrated salt, containing, I should think, half its bulk in HO, I took half of this, or 35 milligrammes, to be the amount of $NaOCO_2$ taken to satisfy 50 milligrammes of boracic acid.

(2). Took half of 5 measures to form BO_3 bead, same size as last. Added drop Co solution and trace of $KOCO_2$ from 5 measures: pink, deeper than soda first trace. Added trace KO; light mauve hot, and light pink cold. Added drop Co solution; dark mauve hot, darkish purple cold. Trace KO; very dark blue hot, dark violet cold. Trace KO; dark mauve-blue hot and cold. Trace more KO; darker blue than last. Trace more KO; deep violet-blue, potash blue. Took half of five measures (50 milligrammes), and, as it was also a hydrated salt, with less HO than the other, I estimated the quantity taken to satisfy the BO_3 as three-fourths of that, or 37·5 milligrammes; but I consider that too much, as I overdid the blue colour, and the KO was evidently more energetic in combinatiou with BO_3 than Na, so that I should think it forms, with that acid, a triborate. I cannot procure caustic soda here, or would not have experimented with the carbonates of those alkalies.

(3). Filled five measures again, and took half to form a bead of BO_3, same size as before. (NB.—The loops of my platinum wires are all twisted of the same diameter). Filled five measures with $CaOCO_2$. Added trace Ca to boracic acid bead, with one drop Co solution; bead pinkish, with undissolved Co in spots. Trace Ca; opaque lavender bead. Trace Ca; bead still opaque, of a blue lavender colour, with spots of undissolved CoO, so added trace KO to clear it, and added trace BO_3 to make up for the KO; bead dark and amethyst. Trace Ca; dark mauve hot, dark amethyst cool. Trace Ca; the mourning-violet colour cool. Trace Ca; deeper colour. Trace Ca; dark violet-blue, lime-blue. Took three-fourths of 5 measures (NB. This powder was extremely fine and dry, so that the above amount, 75 milligrammes, is, if anything, too little). I then made every effort, trying carbon, crystals of a solution of boracic acid in nitrate of cobalt, &c., to get the BO_3 to dissolve the CoO without the addition of an alkali, convinced, if I succeeded, I should get the beautiful wine-red or blood-coloured purple I had observed on the cool part of the platinum wire. I plunged the hot bead into cold water to cool it; I placed two small pieces of platinum wire in its centre for the same purpose, but without effect; and, as you will see from what follows, I found that BO_3 even acted as an alkali itself. Its energies are certainly feeble, and, even with a little KO, it failed to dissolve Cr_2O_3.

Reasoning analogically, I now concluded, as microcosmic salt gave a blue with Co solution not to be distinguished from that of borax, to attempt similar experiments to the above with pure or glacial phosphoric acid. I thought, at first, that I should have to make this myself, but was lucky enough to find two kinds in a chemist's shop here, who uses it in the preparation of some food. The kind which looked the purest, being like ice, I found, on being heated, gave off a smell of ammonia, and became so fluid as to drop off the platinum wire. I applied Co solution to what remained, and it immediately became blue—I presume, from the soda contained in the bones from which it was made. The other, in sticks like those of phosphorus, acted most energetically, and at once dissolved almost any quantity of CoO to a magnificent red-purple bead—the very colour I tried to get out of BO_3 and CoO in vain. On mixing BO_3 with this red-purple bead in considerable quantity, I obtained a blue so deep that it appeared opaque, but, once seen, far surpassed in splendour of colour that of cobaltine borax.

I have not space or time to relate now my experiments with PO_5; but one fact is too important to omit, viz., that, with a slight trace of MnO_2 in the phosphoric bead, I obtained, by the persistent addition of soda, a rich brown colour, without any amethystine tinge, while potash gave, with the same oxide, an amethyst, with a far more purple tint than that of either the borax or microscomic bead does with manganese.—I am, &c.,

W. A. Ross.

Simla, July 15th, 1869.

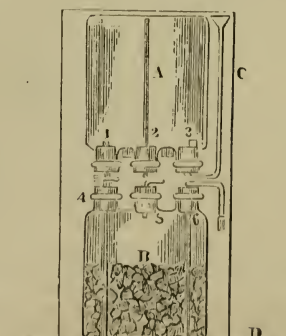
LABORATORY NOTES.

ON A CONVENIENT FORM OF

SULPHURETTED HYDROGEN APPARATUS FOR LABORATORY USE.

Of the many forms of apparatus that have been proposed for the generation of sulphuretted hydrogen, very few allow themselves to be changed so as, at a moment's notice, to give a steady and constant stream of the gas without a slight but continuous escape taking place. In large laboratories, where many analyses are being carried on at the same time, and a large amount of the reagent used, the form described by Fresenius in his "Qualitative Analysis," similar to the hydrogen apparatus used in making sulphuric acid chambers, is all that can be desired. Lead, however, is scarcely a suitable material for smaller apparatus, and glass must be substituted. The old form, with three bulbs, is sometimes used, but these are expensive, and objectionable, inasmuch as, when charged, but not in use, the acid is only prevented from falling and acting on the sulphide by the volume of gas below, so that a variation in the temperature, or very slight leak in the connections, or even the porosity of many varieties of india-rubber tubing, is sufficient to keep up a constant action. The form to be described combines, on a small scale, the advantages of both.

In the figure, A and B are two Woulf's bottles, each furnished with three necks, one held over the other by means of two wooden supports, passing between the necks, and so shaped as to fit the bottle, firmly secured to a backboard, C, which, again, is strongly fixed to the baseboard, D. A may be rendered more secure by further connecting it with the



backboard at the top. Each of the necks is fitted with a good cork. A short and rather broad tube is inserted in cork No. 1. No. 4, opposite to it, is furnished with a tube of equal size, reaching to the bottom of B. These tubes are connected by means of a piece of india-rubber tubing, with sufficient space free to allow of the latter being closed by a Mohr's pinch-cock. Through No. 2 passes a small tube, reaching to the top of A and terminating immediately below the cork. In No. 3 is inserted an acid-funnel, the tube reaching on the inside just above the cork, and bent upward outside, so that the funnel shall be on a level with the top of the apparatus. Through number 6 passes a tube long enough to reach to the bottom of B; the outside end of this is bent downwards, and terminates in a small piece of india-rubber tubing, which can be plugged with a piece of glass rod. The central neck is furnished with an exit-tube for the gas, the stream from which must be regulated by means of an india-rubber tube and screw clamp. About one-third of the lower bottle is filled with small pieces of flint, and on this the sulphide of iron is placed.

To charge the apparatus, the tube at No. 6 is closed, and sufficient acid poured down the funnel to cover the sulphide. When the egress of the gas is stopped, the liquid passes up through No. 4 to A, the air in the latter escaping through the small tube at No. 2. When all the liquid has ascended, the connecting tube at No. 4 is closed by means of the pinch-cock, and the lower bottle relieved from the pressure. When the acid becomes exhausted, it may be drawn off by removing the stopper at No. 6, when, if the liquid is in the upper vessel, it will at once run off; if, however, the exhausted solution is in the lower vessel, it must be removed by blowing in at No. 5. The outside limb of No. 6 may be made long enough to act as a syphon, when the necessity of blowing would be avoided: it would then, however, be easily broken.

E. W. Parnell.

Runcorn, Sept. 25th, 1869.

MISCELLANEOUS.

Discovery of Bismuth Ore.—On an estate belonging to M. Carnac, near Ballhannah, South Australia, a very valuable lode of bismuth has been found, while some miners were seeking for copper ore. Since bismuth has very much increased in price, and is increasingly in demand, this discovery is a highly welcome one.

Incrustations in Boilers may be prevented by introducing raw potatoes, which cause all solid matters to be precipitated at the bottom of the boiler in a fine powder, leaving the sides perfectly free. The experiment was tried with an engine of 8-horse power, into the boiler of which ten kilogrammes of potatoes per week were introduced through the safety-valve. Every week, when the fires were extinguished, the deposit was removed previous to the introduction of a fresh supply of potatoes. On examining the boiler after fourteen consecutive months of work, no traces of incrustation were perceptible; the appearance of the plates was blackish and slightly greasy, and the corners of the joints were in the same state as when first made. Refuse leather-cuttings from the tanneries will answer the purpose equally well.—*Annales de Génie Civil.*

Electro-Plating of Paper or other Fibrous Material.—The *Druggist's Circular* says—"A mode has been devised for depositing copper, silver, or gold, by the electric process, upon paper, or any other fibrous material. This is accomplished by first rendering the paper a good conductor of electricity without coating it with any material which will peel off. One of the best methods is to take a solution of nitrate of silver, pour in liquid ammonia till the precipitate formed at first is entirely dissolved again; then place the paper, silk, or muslin for one or two hours in this solution. After taking it out and drying well, it is exposed to a current of hydrogen gas, by which operation the silver is reduced to a metallic state, and the material becomes so good a conductor of electricity that it may be electro-plated with copper, silver, or gold, in the usual manner. Material prepared in this manner may be employed for various useful and ornamental purposes.

Permanent White, which is necessary in the manufacture of ultramarine, may be formed by adding to the washing waters of that dye sufficient chloride of barium to render the liquid no longer turbid. The precipitate, which is heavy, and falls quickly, may be deprived of a bluish tint by depositing a portion first, with which the ultramarine held in suspension also settles.

Method of Producing upon Iron a Durable Black Shining Varnish.—M. Weiszkopf.—Take oil of turpentine, add to it, drop by drop and while stirring, strong sulphuric acid, until a syrupy precipitate is quite formed, and no more of it is produced on further addition of a drop of acid. The liquid is now repeatedly washed with water, every time refreshed after a good stirring, until the water does not exhibit any more acid reaction on being tested with blue litmus paper. The precipitate is next brought upon a cloth filter, and, after all the water has run off, the syrupy mass is fit for use. This thickish magma is painted over the iron with a brush; if it happens to be too stiff, it is previously diluted with some oil of turpentine. Immediately after the iron has been so painted, the paint is burnt in by a gentle heat, and, after cooling, the black surface is rubbed over with a piece of woollen stuff dipped in, and moistened with, linseed oil. According to the author, this varnish is not a simple covering of the surface, but it is chemically combined with the metal, and does not, therefore, wear off or peel off, as other paints and varnishes do, from iron.

Oxidation of Ammonia.—Chemists are acquainted with the experiment for showing the oxidation of ammonia, in which a red-hot spiral of platinum wire is introduced into a bottle containing a thin layer of strong ammonia on the bottom; white fumes appear of nitrite and nitrate of ammonia. This experiment may be made far more conspicuous in the following manner:—Take a piece of combustion tube, about 40 or 50 centims. in length; place in the middle thereof a layer of 4 or 5 centims. of platinised asbestos. At one of the open ends of the tube a rolled-up piece of blue, and at the other end a similar piece of red, litmus-paper is placed; the last-named open end of the tube is connected, by means of properly arranged tubing, with a flask containing liquid ammonia; the other open end of the tube, where the blue-coloured litmus-paper is placed, is similarly connected with a flask filled with air. The platinised asbestos is next heated to redness, and kept in that state by suitable means. By the employment of a properly arranged tube, a current of air is slowly blown through the flask containing ammonia; when this is continued for a few moments the red litmus-paper will be observed to become blue, and the blue litmus-paper, at the other open end of the tube, will be seen to become red, whilst, at the same time, there will be deposited at the colder portions inside the tube, behind the red-hot platinised asbestos, a broad white ring of nitrite and nitrate of ammonia, while red vapours begin to fill the empty flask. When the gas, after having passed over the platinised asbestos, is made to come into contact with a strong solution of proto-sulphate of iron, to which some few drops of sulphuric acid have been added, this solution soon becomes deep blackish brown. A solution of iodide of potassium, to which a clear starch paste has been added, is, on being brought into contact with this gas, instantaneously coloured blue; while a strong solution of indigo in concentrated sulphuric acid, after having been gently heated, is very rapidly decolourised on coming into contact with this gas.—*Berichte der Deutschen Chemischen Gesellschaft zu Berlin.*

The Proposed New Chair in the Andersonian Institution.—In our Students' Number we stated that Mr. Young's new chair of technical chemistry had been accepted

by Mr. V. H. Perkin; and, as the appointment had received the sanction of the trustees, we were justified in making the announcement. We are, however, now informed that the managers have asked the trustees to cancel the entire arrangement, and we accordingly hasten to notice this fact, especially as the present Professor of Chemistry in the Institution considers our announcement detrimental to his interests. We have received two pamphlets, one being Dr. Penny's remonstrance and appeal against the appointment of an additional Professor of Chemistry, and the other Dr. Adams's reasons of protest; from these we gather that, as Dr. Penny has always instructed his pupils in technical chemistry, and as his income is derived from class-teaching, the new chair would greatly interfere with his interests. Dr. Penny has expressed his willingness to consider any arrangement for carrying out Mr. Young's intentions, provided his titles, rights, &c., are preserved; or, for the actual progress of the Institution, he is willing to vacate his chair on condition of receiving a reasonable compensation for his apparatus and the loss he would sustain. We have no doubt that Mr. Young will adopt some means of carrying out his munificent endowment, without that injury to present interests which it would certainly cause if the original scheme were to be adopted without considerable modifications.

Irrespirable Air of the Wine-Must Fermenting Tubs.—M. Saintpierre.—It is a well-known fact that the four Departments of the South of France, named l'Hérault du Gard, l'Aude, and Pyrénées-Orientales, produce, year after year, about 12,000,000 hectolitres (every hectolitre is rather m e than 22 gallons) of wine; every hectolitre of must gives off an average 2500 litres of carbonic acid gas, and, since the size of the fermenting tubs is such that each one contains with ease 400 hectolitres of liquid, one may readily imagine what a quantity of carbonic acid gas there will be disengaged, considering that, during the short space of from 2 to 3 weeks, from 500 to 1000 hectolitres of must are ready for fermentation in confined localities, generally of no more cubic capacity than 1000 cubic metres (rather more than 35,600 cubic feet). The gas given off during the fermentation has a rather high temperature, and is, moreover, charged with the vapours of various ethers and alcohols, simultaneously the products of the fermentation. Even to those accustomed to this sort of atmosphere its effect upon the system is very marked. Quicklime is very commonly placed in the cellars wherein the fermenting tubs are placed, and a good ventilation kept up. The author of this paper has found, however, that nitrogen is among the products of fermentation; he states that, in 1868, he found that the atmosphere of a large tub could not support the combustion of a candle, although the empty tub (the must and dregs had been removed from it for fully 24 hours before his visit) contained a large quantity of quicklime, and no indication was found of carbonic acid. On analysis of the air contained in this tub it proved to consist, in 100 parts, of:—Oxygen, 11·85; and nitrogen, 88·15. Only the best possible ventilation and plentiful use of lime and lime-water can make cellars wherein these fermenting tubs are placed fit for work-people.—*Journal de Pharmacie et Chimie.*

International Exhibition of Amsterdam.—Professor Pepper is now giving an instructive lecture at the Royal Polytechnic on the "Tentoonstelling." While speaking highly of the inhabitants, the lecturer refers at length to their industrial pursuits, and illustrates the lecture with enlarged views of the Exhibition as well as some curious costumes worn by the Netherlanders. The lecture occupies less than an hour in delivery, and gives a very clear idea of the country and its people.

Glycoblastol.—Under this name there has been brought out at Vienna a cosmetic to be applied to the hair. It is simply made up of glycerine which has been digested with the rind of capsicum and perfumed with patchouli. As glycerine is by no means a proper substance to be applied to hair, this cosmetic, which is sold at an exorbitant price, ought not to be employed.

Fluid Glue.—To 1 kilo of best glue dissolved, by the aid of a gentle heat, in 1 litre of water, 0·2 kilo. of nitric acid at 36° Beaumé (sp. gr. 1·334). After the at first rather strong evolution of nitrous acid vapours has ceased, the liquid is cooled and fit for use; a better product is obtained whem dry clear glue (so-called gelatine) is treated and dissolved on a water-bath in its own weight of strong vinegar, one-fourth of its weight of alcohol, and a very small quantity of alum.

Elastic Glue.—Glue is dissolved in water by the aid of a water-bath, and evaporated until quite a thick fluid is obtained; to this a quantity of concentrated glycerine is added, equal in weight to the quantity of glue taken, and the evaporation is continued, while the mixture is frequently stirred, in order to drive off the remaining water; the mass is then run upon clean marble slabs, and cooled. This material is usefully applied for the inking-rollers of printers, and various other purposes.—*Deutsche Industrieblätter.*

NOTES AND QUERIES.

Estimating Ammonia.—In answer to the query of "A. Z." (Chemical News, vol. xx., p. 156) (*Am. Rep., Nov.*, 1869, *page* 316), respecting a ready commercial method of estimating the percentage of ammonia in sulphate of ammonium, I beg to say that the readiest and most reliable method for this purpose is as follows:—Place a known weight of the salt in a flask fitted with cork and bent tube with bulb (the bend and the bulb are to prevent spirting and carrying over of any caustic liquor by the steam), and, having dissolved in a small quantity of water, distil, with a strong solution of caustic soda, potash, or milk of lime, into a beaker containing a known volume of a titrated solution of hydrochloric acid. The liquid in the flask is boiled till two-thirds are distilled over into the acid, which must be kept cool by immersing the beaker in a vessel of cold water, and keeping a stream of water circulating through the latter during the experiment. The tube is now carefully withdrawn from the acid, still keeping the lamp under the flask, or the contents of the beaker would immediately be sucked back. Just as the tube emerges from the liquid, it is well rinsed with the wash-bottle. The partially-neutralised solution in the beaker is washed out into a basin, tincture of cochineal added, and then the excess of hydrochloric acid is determined at once, in the cold, by means of a sodic carbonate solution of exactly equivalent strength to the hydrochloric acid. The volume of sodic carbonate solution subtracted from that of the hydrochloric acid equals the volume of acid solution required; and the HCl solution should, for the sake of rapidity of working, be so graduated that the number of volumes required should equal the percentage of NH_3 in the salt. If pyrites has been used in the manufacture of vitriol, the vitriol is contaminated with anhydrous persulphate of iron (as a white deposit, which disappears on dilution), and also with a large quantity of arsenic: if, then, iron and a comparatively large quantity of arsenic be found to exist in a sample of vitriol, I think "A. Z." may take it for granted that pyrites has been used in this case. This method is applicable for the estimation of ammonia in any of its salts, providing that these be free from any organic nitrogenous matter. The caustic solutions (potash, soda, or lime-milk) should be well boiled previous to use, and allowed to get quite cold again: this is to free them from all traces of ammonia. In a subsequent communication, I will give the methods for the calculation and construction of volumetric solutions, from which the percentages may be immediately ascertained as being identical with the number of volumes of such volumetric solutions required.—Watson Smith, F.C.S., West Gorton, near Manchester, Sept. 27, 1869.

Carbonic Acid.—Can any of your readers give me some practical information respecting the manufacture of the above by Harrison Blair's process, viz., the passage of common or superheated steam over red-hot limestone enclosed in fire-clay retorts?—Co2.

Spectrum of Sirius.—In the hydrogen line, F, of the spectrum of Sirius, that line is not exactly coincident with the solar line, F. If, then, this deviation exists in that line, should not the like condition occur with respect to the lines of sodium, iron, &c., which I do not understand Mr. Huggins to state?—W. P.

Magic Lantern Light.—I require a powerful light to show to an audience the microscopic image enlarged upon a white sheet in a darkened room, and would take it kind if any of your readers could tell me—(1) Will the magnesium lamp do (the room is a comparatively small one); (2) whether is Solomon's or Larkin's powder lamp best; and (3) where can I obtain or hear of Larkin's lamp (mentioned in the Chemical News, vol. xv., p. 323 (*Am. Rep., Aug.*, 1867, *page* 105)?—C. Hunter.

Detection of Artificially-Coloured Red Wine.—Dr. Wittstein.—The author states that he was desirous to try whether the statement of M. Facen that peroxide of manganese has the property of decolorising naturally red-coloured wine, but leaving the colour of artificially red-coloured wines untouched when, after having been simply for some time in contact with the peroxide, it is filtered off from that material

again. The author had some genuine good red wine, the produce of his own vineyard, and also experimented upon some samples obtained from wholesale houses; and he found that, after treatment with peroxide of manganese, all these samples lost their red colour; and, according to Facen's statement, there might be assumed that none of these samples of wine were artificially coloured. The author then added to a genuine red wine about 1-25th part of its weight of mallow flowers (Flores Malvæ arboreæ), which are largely used for colouring wine; and, at the same time, the author repeated this experiment with a very faintly straw-yellow-coloured white wine, obtaining thus beautifully red-coloured wines. On shaking these up with peroxide of manganese, the artificially-coloured samples were, however, found as readily decoloured after filtration as the genuine red wines had been; therefore M. Facen's test does not hold good.—*Polytechnisches Centralblatt.*

Magnesium Lamps—(Reply to "C. Hunter.")—Messrs. Johnson and Matthey, of Hatton Garden, can give information about, and probably supply, every kind of magnesium lamp.

Magnesium Lamps—(Reply to "C. Hunter.")—Larkin's magnesium powder lamp may be obtained of Mottershead and Co., Manchester.

Halliday's Machines.—Can any of your readers inform me where to find the makers of "Halliday's machines" for treating sawdust in the manufacture of pyroligneous acid and acetate of lime, and also the makers of the best wood-distilling apparatus.—A. W. N.

Carbonic Acid.—(Reply to CO_2).—Why not rather make carbonic acid by Ozouf's process, that is, by forcing air through previously strongly-ignited charcoal, contained in a properly constructed stove or furnace? It is true the gas thus obtained is contaminated with carbonic oxide and a very small quantity of combustible gases. The process alluded to by you is patented, I think, but it is certainly not a cheap process, and, if your limestone is tolerably pure, you had better dissolve it in either hydrochloric or sulphuric acids (both diluted with water of course), and collect the gas thus set free.—J. A.

Tungstate of Soda, &c.—Can any of your readers give us the names of manufacturers of tungstate of soda and tungstate of chrome?—J. C.

Bichromate of Potash.—Can any of your numerous readers inform me if bichromate of potash is manufactured anywhere else except in Scotland?—Bichrome, Glasgow, October 27, 1869.

Detection of Prussian Blue in Black Ink—Can any of your readers kindly inform me how to detect Prussian blue in black ink, that is, if any has been used to give it a blue colour; and also if there is a means of telling when there is logwood used in the preparation, or galls.—J. Kaye.

Footpaths—I wish to lay down a cheap footpath. Can any of your readers inform me of a compound that will harden and not be affected by the weather? I was thinking of using a mixture of tar, pitch, sand, and gravel. What can I add to prevent it softening with the heat of the sun? If there is nothing cheaper, will cement do it? and if so what proportion must be used? Many of the streets in Paris are made with a compound put down in the form of powder, which after having been rolled with heavy rollers, becomes very hard, and forms a smooth and durable road. What is the mixture used?—Roadway.

Purification of Glycerine.—M. Kunath.—The glycerine used largely in those parts of Central Europe where the winters are severe for the filling of wet gas-meters has to be purified again, and concentrated after it has been in use for some time. For this purpose the impure glycerine is poured in a large vessel, and, upon every hundredweight of glycerine, 10 lbs. of iron-turnings are added; the whole mass is thoroughly stirred up, and this stirring repeated for some hours every day for a fortnight. After that period, the mixture is left quietly standing for some weeks, when the clear liquid is withdrawn from the sediment by means of a syphon, concentrated by evaporation, and again used in the gas-meters. The iron-turnings act mechanically as well as chemically: sulphuret of iron is formed, and the formation of this substance aids the precipitation of tarry matters.—*Dresdener Gewerbe Vereins Zeitung.*

Rendering and Bleaching Tallow.—Will any of your practical correspondents kindly give me the best and cheapest methods of rendering and bleaching tallow from rough fat, and how much per cent of tallow should be realised from rough fat rendered by the aid of sulphuric acid (say about 1 per cent of acid); or is that quantity of acid too much, as I find a great variation in the quantity obtained from present results; the quantity of rough fat rendered at each operation is about 3 tons. Is bleaching with black oxide of manganese and sulphuric acid considered the best, or a good method? as I find, in practice, it gives a yellow tinge—occasionally. What may be the cause? as I cannot get the tallow as white as it ought to be; it is more like beef tallow, although it is rendered from a mixture of beef and mutton fat. What substance can be used to precipitate impurities arising from rendering and bleaching when the process of washing is going on? Also, is there any method that can be used to prevent tallow *seeding* (a term generally used in the trade, which denotes the separation of the oily portion from the solid parts), besides continual agitation, until sufficiently cold to be packed?—A Tallow Melter.

Bleaching Syrups.—Can some of your readers give me the following information:—What will bleach syrups (common sugar-house syrup) without expensive apparatus? Will animal charcoal effect the object to any degree?—Andrew van Bibber, Cincinnati, October 14, 1869.

Rendering and Bleaching Tallow.—(Reply to "A Tallow Melter.") This correspondent is referred to Richardson's, Knapp's, and Watts's work on "Chemical Technology;" to Chevreul's work on Fats; and to Wagner's "Lehrbuch der Chemischen Technologie.' There is a French publication on the subject in the useful series known as the "Encyclopédie Roret," published at Paris.

Standard Verification—Having to deal with 1-1000ths of an inch, and having a friend who has to deal with 1-10,000ths of an inch, and finding a deplorable ignorance among the skilled artisans of London and an awful discrepancy with expensive gauges by Holtzaffel's, Elliott, and others, can any correspondent guide me to any system of standard verification? Outside the Greenwich Observatory may be seen a standard of feet, inches, and moderate subdivisions. Is there any inner department for finer minutiæ available for the public?—S. E. P.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Enquirer.—We do not know if Professor Jellet's paper has been published or not.

A Constant Subscriber.—We know of no book treating on the proximate analysis of bodies only, but it is treated of in Watts's "Dictionary" under the word "analysis."

A. B C.—(1) A new work on Dyeing is in the press; (2) Reimann's work on Aniline, price 10s. 10d., post free from our office; (3) Apply to Professor Calvert, at the Royal Institution, Manchester; (4) Animal mordants will fasten aniline dyes on cotton.

J. Coæ.—The subject of your query has already been fully discussed in these columns.

W. H. Hindmarsh.—We know of no analytical practice for disposal just now, or of a partnership in chemical works. By repeating the advertisement, you would probably hear of one. A Mr. G. Green, of 5, Sebbon Street, Islington, has written to us for your address, as he wishes to have his certificate returned.

W. R.—Chloride of iron can only be economically prepared on the large scale at chemical works, where hydrochloric acid can be had at a mere nominal cost. Your other questions can be better answered by a few practical experiments, than by written descriptions. The last of Dr. Angus Smith's articles, "On the Examination of Water for Organic Matter," appeared in No. 510 (*Am. Repr., Nov.*, 1869, *page* 268).

Biggs, Holland, and Biggs.—We do not know the address of MM. Græbe and Liebermann, but a letter to the care of the publishers of the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin* will probably reach them.

Ferrum.—Send us sample, with full particulars, as we know of several who use it.

Amatta.—You will find particulars for making sympathetic ink in Cooley's "Cyclopædia of Practical Receipts."

A Trustee.—It will be necessary for you to send your name and address before we insert your query respecting the Andersonian Institution.

E. N.—Apply to Messrs. Baillière, Regent Street, for the foreign journals you require.

F. Coæ.—You will find information on the Uranium Process for Estimating Phosphoric Acid in Nos. 430 and 432 (*Am. Rep., April and May*, 1868).

Ferrum.—Please forward your address.

Metallurgist.—(1) The latest and most complete treatise on Metallurgy is the English adaptation of Kerl, by Crookes and Rohrig; vol. i. 31s. 6d., and vol. ii., 36s., are published, and vol. iii. is in the press. (2) Mitchell's "Manual of Practical Assaying," edited by William Crookes; price 28s. These works can be obtained at our office. (3) A knowledge of your qualifications would be necessary to answer your other questions.

J. and E. Sturge.—Apply to Asher and Co., Foreign Booksellers, Bedford Street, Covent Garden.

E. U.—Comptes Rendus is published by Gauthier-Villars, Quai des Augustins 55, Paris.

J. Miller.—"Ancient and Modern Industry of the Chinese Empire" is published by Eugène Lacroix, Paris.

An Old Subscriber.—Reimann's "Handbook of Aniline," price 10s. 10d., post free, from our office.

Metallurgist.—You had better advertise in our columns for the situation you require.

W. U.—Mitchell's "Assaying" will answer your purpose best.

Books Received.—"Elements of Chemistry, Theoretical and Practical." By W. A. Miller, M.D., D.C.L., L.L.D., V.P.R.S., &c., fourth edition, with additions. Part III. Organic Chemistry. London: Longmans. "The Ship-Captain's Medical Guide." Compiled by Harry Leach. 3rd edition. London: Simpkin, Marshall, & Co.

"Exercises in Practical Chemistry," by A. G. V. Harcourt, F.R.S., and H. G. Madan, F.C.S. "Chemistry: General, Medical and Pharmaceutical, including the Chemistry of the British Pharmacopœia," by John Attfield, Ph.D. London: John Van Voorst. "A Pharmacopœia, including the Outlines of Materia Therapeutics, for the use of Practitioners and Students of Veterinary Medicine," by Richard Tuson, F.C.S., &c. London: John Churchill and Sons.

AMERICAN SUPPLEMENT.

New York, December, 1869.

Dangerous Kerosene.

Since our last issue went to press, we have noted an unusually large number of kerosene accidents, and as we believe that the public cannot be made to realize the enormity of the crime of selling dangerous burning oils, except by being compelled to read of the horrible results, we condense the following abstract. It must be borne in mind that *not one of these accidents would have occurred had the kerosene oil been of good quality.*

In New York, Sarah Kennedy, 63 years of age, and bedridden, was burned to death by the upsetting of a kerosene lamp at her bedside. A lamp exploded in Martin Leroy's bakery, setting fire to the premises. A kerosene lamp exploded at No. 40, Franklin street; damage trifling. A lamp exploded at 153 Attorney street, seriously burning a young lady. A demijohn of kerosene oil exploded in a store on Avenue A, causing damage to the amount of $300. Bloeuse Cachetsnyder, aged 48, died at 154 Stanton street, from burns caused by the explosion of a kerosene lamp. Two *liquid gas* lamps exploded in the reading-room of Reed's Hotel in Chatham street, severely burning John Ennis, one of the guests. An explosion of kerosene oil occurred in the store of Cornelius Finney, which, together with two adjoining stores, was considerably damaged.

In Brooklyn, Mrs. Sharkey, of 285 Myrtle avenue, was shockingly burned by the explosion of a lamp, which she was in the act of lighting. Edward and Peter Burns were severely burned by the explosion of a kerosene lamp at 15 Carroll street.

In Jersey City, Mrs. McPherson was badly burned by the explosion of a lamp which she let fall.

At South Amboy, Margaret Greenleaf was burned in a horrible manner by the explosion of a kerosene lamp. She survived her injuries twenty-four hours.

In Brooklyn, Ind., a young man who attempted to show his father how a new patent lamp operated, produced a grand explosion of lamp and oil-can, which set fire to the house, and caused damage to the amount of $7,000.

In Buffalo, a lamp exploded at a supper table, severely burning a little girl.

In Cleveland, Ohio, a young girl, who attempted to kindle a fire with kerosene, was fatally burned by the explosion of the can, and died, after lingering two days in great agony. In the same city a "non-explosive" lamp, filled with "non-explosive" oil, and capped with a "non-explosive burner," exploded.

In Troy, N.Y., a Mrs. Campbell was burned in the most shocking manner by the explosion of a lamp. Every part of her body, except the face, was exposed to the flames.

In Harwich, Mass., two little girls of six and four years respectively, were left with a kerosene lamp burning in the chamber in which they had been put to bed. Not long afterwards the house took fire and the children perished. As there were no fires burning in the house, there is every reason for believing that the kerosene lamp exploded while the children were asleep. The mother is now a maniac.

In Milwaukee, during a fencing scene at the Gaiety Theatre, one of the rapiers struck a kerosene lamp, which exploded, setting fire to the scenery. Before the audience had escaped from the building it was enveloped in flames. Fifteen or twenty persons were badly burned, besides several who were burned to death, or killed in the confusion which succeeded the accident.

At Spartansburg, Penn., a lady died from burns caused by the explosion of a kerosene lamp.

Such is the very imperfect record for November. *Some one person is responsible for each of these accidents —the person who sold the dangerous oil.* Many dealers do not know how dangerous their oils are; the wholesale dealers assure them that their particular brand is safe. These men must be educated—educated by the press—to a full appreciation of the importance of safe kerosene. They should procure an oil-tester, and learn to test the oil for themselves, and prosecute the wholesale dealers who supply them with a dangerous article. There are many dealers, however, wholesale and retail, who know well what they are selling, but who would sell their souls for a trifling gain. Such men must be reached by the strong arm of the law.

How can the sale of dangerous kerosene be prevented? is a question which I hear frequently asked. One writer says, punish the manufacturers and wholesale dealers. Another thinks it is very hard to compel the poor woman who keeps a china and lamp stall, and sells kerosene by the pint from a two-gallon can, to have her oil tested or to pay a fine of fifty dollars—her entire capital—if she is unfortunate enough to be supplied with dangerous kerosene by the pedler who calls twice a week. We say, make the penalty for selling dangerous kerosene as severe as possible—a heavy fine for the first offence, fine and imprisonment for the second. If it is found that small dealers cannot manage the business without serious danger to the public, then let them pursue some occupation less hazardous to their customers. Adopt a license system, and bring the sale of kerosene under municipal control at once, like that of gunpowder. We are satisfied that as soon as the public fully understands that *with safe oil no accidents occur*, the question of securing safe oil will be speedily settled.

In New York and Brooklyn the Board of Health and the Fire Commissioners are actively engaged in testing oils and in prosecuting the dealers, and we hope before long to record the conviction and punishment of some of them.

In Chicago the law against the sale of dangerous kerosene is about to be rigidly enforced.

Experiments have been recently made by agents of the Treasury Department, with regard to the quality of the oils used in the Western States, and we are informed that the present steamboat law is to be enforced to prevent the use or transportation of explosive or unsafe oils by river steamboats.

All this is very encouraging, but much remains to be done. We hope every writer for the press will say a good word for the cause, and that dangerous kerosene, which is now the rule, will soon become the exception.

Fire-Marshal Brackett reports:

Fires in New York during the year ending October 30th, 913; of which 98 were caused by Kerosene, Liquid Gas, and Gasolene; estimated damage caused by these 98 fires, $72,720. More than ten per cent. of the fires caused by kerosene, etc. How can we convey any adequate of the human suffering endured by the victims of the explosions.

The Explosion in Brooklyn.

On the evening of October 25th, an explosion occurred in Brooklyn, N.Y., at the Robbins' Wood Preserving Works. Martin Voorhees, of Princeton, N.J., was engaged in testing what he considered an improved apparatus for applying the Robbins process. Mr. Robbins' apparatus consists of a long iron cylinder, into which cars loaded with the wood to be treated are run. The ends of the cylinder are closed by heavy doors, securely fastened. From an adjoining still the vapors from heavy oil of coal-tar are driven over into the cylinder; and by the high temperature and the condensing vapors, the water of the wood is rapidly replaced by the oils rich in carbolic acid. Mr. Voorhees considered the separate still superfluous, and constructed a fire-box with a broad grate directly beneath his cylinder, which heated the entire length of the cylinder for a width of about two feet; the rest of the cylinder, which was about eight feet in diameter, being cold. Heavy oil of coal-tar was placed in the bottom of the cylinder to a depth of five or six inches, the cars loaded with wood were run in, the doors secured, and a fire kindled beneath the cylinder, about eight bushels of anthracite coal being ignited. After a time considerable water began to leak out around the joints of the doors at the ends of the cylinders; the couplings were then tightened. Just before the explosion the very sensitive pressure-gauge showed no pressure, but suddenly the doors were blown out, killing Mr. Voorhees and a laborer, and severely injuring a boy who was standing near. The roof was blown off, and the wooden structure which covered the cylinder was set on fire and destroyed. The violence of the explosion must have been great, as the doors were of cast and wrought iron, three-fourths of an inch thick. They were hung on massive hinges, and bolted all round their circumference to the flanges of the cylinder. It is not quite clear how the explosion was caused. That it was not due to a gradually-increasing pressure is shown by the fact that a moment before neither the pressure-gauge nor the safety-valve gave any indication of pressure. Two theories have been proposed to account for the sudden explosion: either it was due to the formation of an explosive mixture of air and hydrocarbon vapors, or to the sudden contact of a quantity of condensed water from the wood with the highly-heated heavy oil. Mr. Voorhees had provided means for intercepting the water which might condense on the cooler surface of the cylinder, by placing gutters of angle-iron on each side, about a foot above the surface of the oil, and running the entire length of the cylinder. These gutters could be emptied occasionally by means of cocks on the outside, but had not been attended to before the explosion occurred. Very probably the heavy oil boiled up and thus came in contact with the matter in the gutters. It should be distinctly understood that it was not the Robbins apparatus but the Voorhees apparatus which exploded.

On a New Tartrate of Iron.

BY DR. ISIDOR WALZ.

A solution of protoxide of iron to which tartaric acid has been added, remains colorless on the addition of ammonia, nor does a solution of sesquioxide of iron change its color materially under the same circumstances; but it is otherwise when both oxides are present in the same solution. In this case the addition of tartaric acid, and subsequently of ammonia, produces a beautiful green color when the oxides are present, in the proportion of their chemical equivalents, *e.g.*, in a solution of magnetic iron-ore; when the proportions are different, the color is either a dirty or yellowish-green, according to circumstances. This color is in all cases quite evanescent, passing to brown in the course of a few hours by oxidation, rendering it impossible to obtain the salt in solution in a dry state by evaporation or desiccation.

A solution of Fe_2Cl_6 was reduced by means of zinc, and when the reduction was complete one portion of it was immediately treated with a solution of tartaric acid and supersaturated with ammonia; the solution was colorless. The other portion was allowed to stand a short time, and on being treated in the same manner, showed a fine green color. A part of the ferrous oxide had consequently been *oxidized* to the ferric state.

On the other hand, a solution of Fe_2Cl_6 was precipitated with ammonia, the precipitate washed and dissolved in tartaric acid till the solution was of a deep-red color. A portion of this solution was supersaturated with ammonia, when it changed its color slightly to brown; the other portion was allowed to stand over night, and when ammonia was added to this, the green color appeared, showing that the ferric oxide had been partially *deoxidized*.

Concluding from this that the green-colored liquid was the ammoniacal solution of the tartrate of magnetic oxide of iron, I prepared a quantity of this oxide artificially, and brought it into a boiling solution of tartaric acid. The black, granular oxide was soon transformed into a pale-green impalpable paste, which dried on the filter to a coherent mass. (This mass, ground fine, would be well adapted for use as a water-color.) Both before and after drying it was soluble in ammonia, with a green color which passed rapidly into brown; and though I have not yet analyzed this powder, I have no doubt that it is the double tartrate of ferric and ferrous oxide, composed, apart from the water of hydration, analogously to the tartar emetic, viz.:

$$\overline{\overset{\text{VIII.}}{K_2Sb_2}},\ 2(C_4H_2O_7).$$

$$\overline{\overset{\text{VIII.}}{Fe_2}},\ 2(C_4H_2O_7).$$

Dualine.

Capt. Von Schelihа, of the Prussian army, has recently brought to this country a specimen of the new explosive agent, which is proposed as a substitute for gunpowder, nitroglycerine, and dynamite. Dualine was invented by Lieut. Dittmer, of the Prussian artillery, who was for some years assistant director of the royal powder mills at Spandau, and afterwards director of Mr. Nobel's nitroglycerine factory.

We cannot give the composition of this new agent, as although it is patented in the United States, the inventor prefers to withhold the details of its manufacture for the present.

It is claimed that Dualine possesses all the advantages of nitroglycerine and dynamite, with none of their disadvantages.

Hot and cold, dry and damp weather have no effect upon it.

It does not pack.

It is not liable to spontaneous decomposition. Burns quietly in the open air, exploding only when tamped in a blast hole or in a torpedo.

It is not exploded by concussion, and may therefore be used in shells.

It evolves, on explosion, no disagreeable gases.

It costs less than nitroglycerine or dynamite, and relatively less than gunpowder.

We cannot vouch for all these statements from our own experience; but we handled Dualine; endeavored in vain to explode it by blows; and saw it burn quietly in a grate fire. If future experiments fully establish all that is claimed for this agent, and as we have full confidence in the statements of Capt. Von Scheliha, we have no doubt they will, Dualine will be a very important agent in the western mines.

The Saratoga Seltzer Spring.

This spring is situated about seventy-five feet south of the High Rock Spring, in the village of Saratoga. It was discovered many years ago, and from the fact that a barrel was sunk into the ground to serve as a reservoir for it, it was called the "Barrel Spring." It received but little attention, however, and was suffered gradually to fill up with earth and stones.

In 1865, the property on which the spring is situated having changed hands, an excavation was made to tube the spring. This excavation penetrated the following strata, down to the limestone rock:—

1. 5 feet Muck. The original soil of the swamp.
2. 4 " Calcareous tufa. A hard stony layer.
3. 21 " Blue clay.
4. 4 " Hard pan.
5. Limestone. "Calciferous lime rock."

The tufa, which must have been formed by the waters of the spring, and which consists of the same materials as the celebrated "High Rock" of the neighboring spring, gave the following results on analysis:—

Carbonate of lime	87·83
Carbonate of magnesia	1·76
Oxide of iron	1·71
Alumnia	3·38
Sulphate of lime	trace
Silica (soluble)	0·16
Sand and clay (insoluble)	2·96
Organic matter	1·09
Moisture	0·50
Undetermined	0·61
	100·00

The carbonates of lime and magnesia were evidently derived from the water of the spring, the other constituents chiefly from the soil. This layer of tufa is more or less porous, with numerous cavities, in some of which small stalactitic masses of nearly pure carbonate of lime occurred. Leaves, twigs, nuts, snail shells, etc., were occasionally seen in this bed. A wooden hopper, five feet high and six feet square at the rim, was placed over the opening from which the spring flowed, and was securely tamped with clay to prevent leakage and exclude surface water. To the hopper was attached a wooden tube twelve inches square and twenty-nine feet long, which raised the water to the level of the ground. Above this was placed a glass tube three feet high. The entire depth therefore of the tube is thirty-seven feet. The water flows over the rim of the glass tube, but the pressure of the column of water reduces the flow of the spring to a small fraction of what it was while the excavation was open. The flow of gas is abundant and constant, but every few minutes there is a momentary evolution of an extraordinary quantity. The appearance of this fountain, on a bright sunny day, is most beautiful; the bubbles of carbonic gas, as they rise through the water, appearing like struggling globules of mercury.

The temperature of the water is 50° F. The taste is acidulous and saline, and much milder than that of any of the other Saratoga Springs.

Its resemblance in flavor to the celebrated Selters, or Seltzer water of Germany, was noticed by all who were acquainted with that water, and it has consequently received the name Saratoga Seltzer Spring by common consent.

The following are the results of the analysis of this water, made by C. F. Chandler and Paul Schweitzer. An analysis of the German Seltzer water by Kastner is inserted for comparison. In one United States gallon of 231 cubic inches are contained:

	Saratoga Seltzer.	German Seltzer.
Chloride of sodium	234·291 grs.	132 673 grs.
Chloride of potassium	1·335	0·469
Bromide of sodium	0·630	0·001
Iodide of sodium	0·031	
Fluoride of calcium	trace	0·012
Bicarbonate of lithia ($LiO,HO,2CO_2$)	0·899	·005
Bicarbonate of soda	29·428	77 295
Bicarbonate of magnesia	40·339	22·354
Bicarbonate of lime	89·869	19·288
Bicarbonate of strontia	trace	0·083
Bicarbonate of baryta	trace	
Bicarbonate of iron	1·703	0·919
Bicarbonate of manganese		0·027
Biborate of soda	trace	
Phosphate of lime	trace	2·328
Alumina	0·374	trace
Silica	2·561	1·905
Organic matter	trace	
Total	402·017 grs.	259·576 grs.
Carbonic acid gas	324·08 cubic in.	228·736 cubic in.

From these analyses it appears that the Saratoga Seltzer contains a few substances not found in the German spring, and although these substances occur in very small quantities, they undoubtedly add to the value of the water.

Recent Chemical Patents.

Issued October 19, 1869.

95,882—Manufacture and Preservation of Metals.—J. Corson, Washington, D. C.

95,931.—Process for Amalgamating Gold and Silver.—A. B. Paul, San Francisco, and J. L. Wood, Independence, Cal.

95,933.—Manufacture of Iron and Steel.—J. Player, Philadelphia, Pa.

95,939.—Preserving Dead Bodies.—G. W. Scollay, St. Louis, Mo.

95,941.—Manufacture of Illuminating Gas.—B. Silliman, New Haven, Conn.

95,970.—Composition for Cleaning Stone.—F. Baumann, Chicago, Ill.

96,029.—Distilling Whiskey, and Other Spirits.—J. S. Oliver and E. Harris, New York.

96,056.—Apparatus for Ageing Spirituous Liquors.—R. D. Turner, New York.

Issued October 26, 1869.

96,097.—Process of Obtaining Useful Oil from the Acid Residuum of Petroleum.—A. Farrar, Longwood, Mass.

96,132.—Mode of Producing Useful Articles from Collodion and its Compounds.—J. A. McClelland, Louisville, Ky.

96,148.—Compound for Making Water-Proof Paper.—C. S. Rauh, Boston, Mass.

96,155.—Machine for Bleaching Cane-Juice.—E. Skelly, Plaquemine, La.

96,197.—Mode of Cleaning Gas Retorts.—C. A. Bush, New London, Conn.

96,201.—Distilling and Treating Alcoholic Spirits.—G. Clark, Buffalo, N. Y.

96,237.—Rubber Compound for Packing.—J. Johnson, Brooklyn, E. D., N. Y.

96,239.—Process of Reducing Wood and Woody Fibres for Paper Pulp.—V. E. Keegan, Boston Highlands, Mass.

96,241.—Method of Recovering Grease from Waste Soap Liquors.—W. Kœhler, Norwalk, Conn.

96,242.—Coloring Material for Dyeing and Printing.—C. Lauth, Paris, France.

96,243 —Fuel for Metallurgic Purposes.—C. E. Lester, New York.

96,248.—Explosive Compound.—W. Mills, New York.

Issued November 2, 1869.

96,345.—Solid or Dry Extract of Bark for Tanning.—J. Pickles, Wigan, England.

96,365.—Making Tanning and Dyeing Extracts.—B. C. Tilghman, Philadelphia, Pa.

96,374.—Manufacture of Carbonate of Soda.—O. Wuth, Pittsburg, Pa.

96,409.—Process for Producing Carbon Pigments.—A. Farrar, Boston, Mass.

96,423.—Rendering Animal Fat.—H. E. Gotleb, New York.

96,524.—Process of Refining the Waste from German Silver and Other Metals.—F. Wilcox, Waterbury, Conn.

96,525.—Process of Utilizing the Waste formed in Cleaning Copper and Brass Goods.—F. Wilcox, Waterbury, Conn.

Issued November 9, 1869.

96,633.—Process and Apparatus for Converting Cast-Iron into Steel.—A. Thoma, New York.

96,640.—Distilling Alcoholic Liquors.—S. F. Van Choate, Boston, Mass.

96,661.—Process for Coloring Muslin, Paper, &c.—F. Beck, New York.

96,721.—Process for Purifying Pyroligneous and Acetic Acids.—C. C. Parsons, New York.

96,755.—Reducing Ores.—C. D. Williams and W. H. Nobles, Saint Paul, Minn.

Issued November 16, 1869.

96,790.—Process for Reducing Rebellious Ores of the Precious Metals.—A. I. Frick and J. B. LeClerc, San Francisco, Cal.

93,872.—Furnace and Process for Treating and Reducing Ores, &c.—V. W. Blanchard, Bridgport, Vt.

97,001.—Mode of Collecting and Storing Carbonic Acid for Extinguishing Fires.—E. Thayer, Worcester, Mass.

97,004.—Artificial Marble.—C. Volckmann, Columbus, Ohio.

97,007.—Compound Soap.—A. Warfield, Alexandria, Va.

97,017.—Process of Manufacturing Steel.—J. J. Johnston, Alleghany, Pa.

Reissues.

90,160, reissue 3,677.—Manufacture of Glue.—W. A. Fleck, Philadelphia, Pa.

86,835, reissue 3,688 —Process of Utilizing the Waste Products of Combustion for the Manufacture of White Lead, and for Other Purposes.—H. Hannen, Philadelphia, Pa.

NEW PUBLICATIONS.

The American Journal of Science and Arts for November contains the following articles specially interesting to chemists: 1. On Certain Compounds of Chromium and Iron, by J. H. H. Corbin. 2. Examination of a Supposed Hercynite, by C. A. Walle. 3. On the Proximate Composition of Several Varieties of American Maize, by W. O. Atwater, Ph.D. 4. On the Magnetite in the Mica of Pennsbury, Pa., by James D. Dana and G. J. Brush. 5. On the Probable Origin of Albertite and Allied Minerals, by S. P. Peckham.

Manual of Qualitative Chemical Analysis. By Prof. Charles W. Eliot and Prof. Frank H. Storer. 191 pp. D. Van Nostrand, New York. 1869.

A Short Course in Qualitative Analysis (with the new notation). By Prof. J. M. Crafts. 131 pp., with tables. John Wiley & Son, New York. 1869.

Agricultural Qualitative and Quantitative Chemical Analysis. By Prof. G. C. Caldwell. 307 pp. Orange Judd & Co., New York. 1869.

Abstract of a Paper on Atomic Motions read before the Chicago Meeting of the American Association for the Advancement of Science. By Prof. H. F. Walling. 16 pp. Salem, Mass.

Contributions to the Mineralogy of Nova Scotia. By Prof. How. 8 pp. From the *Phil. Mag.* for April, 1869.

Die Gliederung der eozoischen Formationsgruppe Nord-Amerikas. Von Dr. H. Credner. 53 pp. Halle. 1869.

On the Relation between the Intensity of Light Produced from the Combustion of Illuminating Gas and the Volume of Gas Consumed. By Prof. B. Silliman. Paper read at the Salem Meeting of the American Association for Advancement of Science, Aug. 1869. 8 pp. New Haven. 1869.

A Lecture on Measures and Weights. By Prof. Sidney A. Norton. 21 pp. Cincinnati. 1869.

The Surface Geology of the Basin of the Great Lakes and the Valley of the Mississippi. By Prof. J. S. Newberry. 24 pp. Reprinted from the Annals of the New York Lyceum of Natural History. 1869.

Notes on the Geology of Western Texas and Chihuahua. By James P. Kimball, Ph D. 10 pp. Reprinted from the *American Journal of Science and Arts* for Nov., 1869.

The Physical Survey of Virginia. By Prof. M. F. Maury. 100 pp., with Maps. Second Ed. D. Van Nostrand, New York. 1869.

First Annual Report upon the Geology and Mineralogy of the State of New Hampshire. By Prof. C. H. Hitchcock, State Geologist. 36 pp. Manchester, N. H. 1869.

Annual Report of the Surgeon-General of the United States Army. By J. K. Barnes, Surgeon-General. 11 pp. Washington, D. C. 1869.

BREVITIES.

American Institute Lectures.—At the last meeting of the American Institute, the Committee on Scientific Lectures announced the following course for this winter:—

1. Friday, December 17, 1869. Battle-Fields of Science. By Andrew D. White, President of Cornell University.
2. Friday, December 24, 1869. How Animals Move. By Prof. E. S. Morse, of the Peabody Academy of Science.
3. Friday, December 31, 1869. The Correlation of Vital and Physical Forces. By Prof. G. F. Barker, of Yale College.
4. Friday, January 7, 1870. The Air and Restoration. By Prof. J. C. Draper, of the College of the City of New York.
5. Friday, January 14, 1870. The Connection of Natural Science and Mental Philosophy. By Prof. J. Bascom, of Williams College.
6. Friday, January 21, 1870. The Constitution of the Sun. By Dr. B. A. Gould, of Cambridge, Mass.
7. Friday, January 28, 1870. The Colorado Plateau—Its Cañons and Ruined Cities. By Prof. J. S. Newberry, of Columbia College School of Mines.

Manufacture of Nickel.—The Nickel Works of Joseph Wharten, Camden, N. J., employ at the present time 50 men. The ore used at this establishment is procured from Chester County, and is said to be of a very superior quality. Nickel is a scarce metal, and always occurs in combination with other metals. When pure, it is of a fine white color resembling silver. It is rather softer than iron; its specific gravity when cast is 8 279; when hammered, 8 932. The cobalt ores are commonly employed in the extraction of nickel, and they are now treated by the method of Wohler to effect the separation of the two metals. The arsenic is expelled by roasting the powdered speiss or ore first by itself, next with charcoal powder till the garlic smell is no longer perceived. The residuum is mixed with three parts of sulphur and one of potash, melted in a crucible with a gentle heat, and the product being edulcorated with water, leaves a powder of metallic lustre, which is a sulphuret of nickel free from arsenic; while the arsenic associated with the sulphur and combined with the resulting sulphuret of potassium, remains dissolved. The sulphuret must be finally washed, dissolved in concentrated sulphuric acid, with the addition of a little nitric; the metal must be precipitated by a carbonated alkali, and the carbonate reduced with charcoal. The nickel made at the Camden Works is sold, or a portion of it, at the Mint in this city, and forms twelve per cent. of the new cent authorized by Congress in 1857.—*Philadelphia Ledger.*

Street Cleaning by the Board of Health.—Dr. Elisha Harris, the Sanitary Superintendent of the Metropolitan District, which includes New York and Brooklyn, reports that there were cleaned under his direction, between the 14th of July and the 1st of Oct., an average of forty-five miles of street per week. The dirt was hoed and swept up, the gutters were cleaned, the hydrants were freely used for washing the streets and gutters, and disinfectants were used when necessary. Of heavy oil of coal-tar 2695 gallons were employed; of quicklime, 263 casks; of chloride of lime, 1952 pounds. The disinfectant now recommended for privies and cesspools is a mixture of sesquichloride of iron and carbolic acid. It is sold in New York under the name of the "Metropolitan Disinfecting Fluid."

A Grand International Exhibition, or World's Fair, will be opened on the 1st of September, 1870, at Saragossa, the capital of Aragon, in Spain. Every advantage is offered to exhibitors—such as free entry, half rates for freight on the railroads, etc. For further particulars address Francisco de Carpi, Spanish Vice-Consul, No. 29 Broadway, New York.

Destruction of a Cabinet by Fire.—A destructive fire occurred at the Rochester University on the evening of Oct. 9th, by which the laboratory, workshop, and private mineralogical, zoological, and other cabinets of Prof. Henry Ward, as well as his great collection of plaster casts, moulds, models, etc. were destroyed. The large cabinets sold by Prof. Ward to the University a few years since were not injured.

A Liberal Gift for Scientific Purposes.—Mr. Orange Judd, the proprietor of the *American Agriculturist*, has given $50,000 to the Wesleyan University at Middletown, Conn., for the erection of a building for the department of natural science.

The Scientific Congress of France has just held its thirty-sixth session at Chartres, under the Presidency of M. de Caumont. The proceedings lasted eight days.

AMERICAN DRUGGISTS' PRICE-CURRENT—NEW YORK.—JOBBERS' PRICES.

DRUGS AND CHEMICALS.

Aceton	per oz	to	35	
Acid, Acetic, No. 8	per lb	to	22	
sp. gr. 1.047 U.S.P	per lb	to	25	
Chemically Pure	per lb	to	55	
Glacial	per lb	to	1 60	
Benzoic, German	per oz	to	30	
Boracic, pure	per lb	to	85	
Citric	per lb	to	93	
Fluoric, 1 lb bottles	per lb	to	2 30	
Formic	per lb	to	3 00	
Gallic	per lb	to	2 75	
Hydrophosphorous	per lb	to	4 25	
Lactic	per lb	to	4 25	
Muriatic, 18 degrees	per lb	to	5	
chemical pure	per lb	to	35	
Nitric, 38 degrees	per lb	to	15	
chemical pure	per lb	to	38	
Oxalic, patent	per lb	to	30	
Phosphoric, glacial	per lb	to	3 00	
Prussic	per oz	8 to	9	
Sulphuric	per lb	4 to	5	
chemical pure	per lb	to	48	
Valerian	per oz	to	1 40	
Tartaric, powdered	per lb	to	75	
Aconite Leaves	per lb	to	28	
Aconitia	per dr	to	5 00	
Agaric Alba	per ib	to	80	
Alcohol, 95 per ct	per gal	to	2 50	
Aloes, Cape, powdered	per lb	to	34	
Socotrine, powdered	per lb	to	1 00	
Alum, Roman	per lb	to	11	
lump	per lb	to	4½	
Ambergris, gray	per oz	to	14 00	
Ammonia Carbonate, bulk	per lb	to	22	
in jars	per lb	to	23	
Muriate	per lb	to	16	
Ammonia Aqua, 20 degrees	per lb	to	12	
26 degrees	per lb	to	22	
Hypophosphite	per lb	to	4 00	
Oxalate	per lb	to	2 00	
Phosphate	per lb	to	2 00	
Sulphate	per lb	to	10	
Ammonium Valerian. Crystals	per oz	to	1 10	
Ammonium Bromide	per lb	to	2 00	
Hydrosulphuret	per lb	to	75	
Iodide	per lb	to	8 50	
Amygdalin	per oz	to	3 75	
Antimony and Potass	per lb	to	1 10	
Butter	per lb	to	28	
Arnica Leaves	per lb	to	20	
Arrow Root, Bermuda	per lb	to	45	
St. Vincent	per lb	to	18	
Arsenic, white powdered	per lb	8 to	10	
red pulv	per lb	to	30	
red. lump	per lb	to	20	
Arsenic Solution, Fowler's	per lb	to	15	
Iodide	per oz	to	90	
Sol., Donovan's	per lb	to	28	
Asbestos	per lb	to	15	
Asparagin	per oz	to		
Atropia	per dr	to	3 00	
Sulphate	per dr	to	3 00	
Valerian	per dr	to	4 50	
Balsam Fir	per gal	to	3 50	
Copaiva	per lb	to	95	
Peruvian	per lb	to	6 50	
Tolu, true	per lb	to	1 25	
Barbadoes Tar	per lb	to	12½	
Bark, Elm	per lb	to	18	
Bark, Calisaya, quill	per lb	to	1 65	
Red, quill	per lb	to	1 80	
Pitaya	per lb	to	80	
Cascarilla	per lb	to	22	
Mezereon	per lb	to	28	
Sassafras	per lb	to	10	
Baryta Muriate	per lb	to	30	
Nitrate	per lb	to	40	
Bay Rum	per gal	to	3 00	
Bebeerin, pure	per oz	to	5 50	
Sulphate	per oz	to	3 50	
Belladonna Leaves	per lb	to	25	
Bicarbonate Soda	per lb	to	6	
Bichromate Potash	per lb	to	22	
Bismuth Metallic	per lb	to	8 00	
and Ammonia Citrate soluble	per oz	to	90	
and Ammonia Citrate Solution	per lb	to	95	
Oxychloride	per lb	to	6 75	
Subcarbon	per lb	to	7 75	
Sub-Nitrate	per lb	to	6 75	
Tannate	per oz	to	1 30	
Valerianate	per oz	to	2 35	
Black Drops	per b	to	5 00	
Blue Mass	per lb	to	54	
Bole, Armenia true	per lb	to	10	
Borax, refined	per lb	to	38½	
Brimstone, roll	per lb	to	5	
Bromine	per lb	to	2 50	
Brucia	per oz	to	3 75	
Buchu Leaves, long	per lb	to	60	
short	per lb	to	38	
Burgundy Pitch, true	per lb	to	14	
Cadmium, Bromide	per oz	to	40	
Iodide	per oz	to	55	
Metallic	per lb	to	4 40	
Sulphate	per oz	to	35	
Caffeine	per oz	to	8 25	
Calcium Chloride	per lb	to	20	
Iodide	per oz	to	50	
Calisaya Bark, Milhau's Original Elixir of	per doz	to	11 00	
" " "	per gross	to	120 00	
Calisaya Bark, Milhau's Chalybeate Elix. of	per doz	to	11 00	
" " "	per gross	to	120 00	
Calomel, Hydrosub	per lb	to	1 00	
Camphor, Refined	per lb	to	85	
Cannella Alba	per lb	to	25	
Cantharides, powdered	per lb	to	2 50	
Carbolic Acid crystals	per oz	to	15	
" " solution	per lb	60 to	85	
" " common	per lb	to	35	
Carbon Bi-Sulphuret	per lb	to	42	
Cascarilla Bark	per lb	to	20	
Cassia Buds	per lb	to	1 10	
Castor Oil	per gal	to	2 50	
Caustic Soda	per lb	to	8½	
Centaury Minor	per lb	to	30	
Cerium, Oxalate	per oz	to	1 05	
Nitrate	per oz	to	1 60	
Chalk Precip., English	per lb	to	23	
Cherry Laurel Water	per lb	to	58	
Chlorate Potass, English	per lb	to	46	
Chloride Lime	per lb	to	8	
Chloroform	per lb	to	1 32	
Cinnamon, Ceylon, true	per lb	to	1 70	
Citrine Ointment	per lb	to	58	
Civet	per oz	to	5 50	
Cobalt	per lb	to	26	
Cocculus Indicus	per lb	to	86	
Cocoa Butter	per lb	to	95	
Codeine	per dr	to	2 50	
Cod Liver Oil	per gal	to	2 10	
Cod Liver Oil, (" Shore Oil ")	per gal	to	2 00	
Cod Liver Oil, J. C. Baker & Co.'s	per doz	to	2 00	
" " "	per gross	to	90 00	
" " "	.5 gross, per gr	to	87 00	
Cod Liver Oil, Hazard & Caswell's	per doz	to	7 50	
" " "	per gr	to	90 00	
Cod Liver Oil, Milhau's Golden	per doz	to	7 00	
" Milhau's Etherized	per gross	to	78 00	
Cod Liver Oil, Milhau's, with the Hypophosphite of Lime	per doz	to	7 50	
	per gross	to	84 00	
Collodion	per lb	to	1 60	
Cantharidal	per doz	to	4 50	
Colocynth, powdered	per lb	to	72	
Confectio Rosæ	per lb	to	45	
Sennæ	per lb	to	45	
Conium Leaves	per lb	to	25	
Coniin	per oz	to	7 50	
Copper Ammoniated	per lb	to	1 20	
Black Oxide	per lb	to	2 20	
Carbonate	per lb	to	2 20	
Sulphate, pure	per lb	to	38	
Copperas	per lb	to	4	
Corrosive Sublimate	per lb	to	90	
Cream Tartar, powdered, pure	per lb	to	45	
Cubebs	per lb	to	20	
Cubebin	per dr	to	25	
Cuttlefish Bone	per lb	to	28	
Digitalis Herb	per lb	to	18	
Digitaline	per dr	to	3 65	
Dover's Powder	per lb	to	2 75	
Dragon's Blood, mass	per lb	to	1 00	
reeds	per lb	to	1 10	
Dulcamara Stems	per lb	to	18	
Emetine	per oz	to	3 65	
Emery Corn	per lb	to	10	
Flour	per lb	to	7½	
Epsom Salts	per lb	to	4½	
Ergot, new	per lb	to	1 00	
Ergotine	per oz	to	1 10	
Ether, Acetic	per lb	to	80	
Butyric, concentrated	per lb	to	3 75	
Butyraceous	per lb	to	1 50	
Chloric	per lb	to	85	
concentrated	per lb	to	1 30	
Formic	per lb	to	4 00	
Sulphuric	per lb	to	68	
washed	per lb	to	78	
concentrated	per lb	to	85	
Extr. Jockey Club, Chbls	per lb	to	3 65	
Extr. Ess. Bouquet, Chbls	per lb	to	3 75	
Extr Banana, superlor	per lb	to	1 25	
Extr. Orange, superlor	per lb	to	1 25	
Fluor Spar	per lb	to	16	
Flowers, Althea	per lb	to	42	
Arnica	per lb	22 to	24	
Borrago	per lb	to	95	
Chamomile, German	per lb	to	40	
Chamomile, Roman, 1867	per lb	86 to	88	
Lavender	per lb	to	8½	
Malva, large	per lb	to	40	
small	per lb	to	45	

Flowers, Rosemary	per lb		to	68
Tiliae	per lb		to	68
Violet	per lb		to	68
Fusel Oil, purified	per lb		to	2 00
Ferro - Phosphorated Elixir of Calisaya Bark, Hazard & Caswell's,	per doz		to	12 00
	per grs		to	144 00
Gamboge	per lb		to	1 10
Gelatine French Pink	per lb		to	1 38
Gelatine, White French	per lb	85	to	1 00
Cox's	per doz		to	2 00
Ginger, Jamaica, bleached	per lb		to	26
Ginseng	per lb		to	80
Glauber Salts	per lb	3	to	
Glycerine, common	per lb		to	35
concentrated	per lb		to	50
"Bowers"	per lb		to	80
"Price's"	per lb		to	1 00
Glycerole Hypophosphite	per lb		to	1 75
Grains D'Ambrette	per lb		to	58
Paradise	per lb		to	28
Gum Acroides	per lb		to	24
Amber	per lb		to	50
Ammoniac	per lb		to	60
Arabic, Turkey, sorts	per lb		to	55
1st picked, Trieste	per lb		to	95
2d " "	per lb		to	75
3d " "	per lb	55	to	60
Barbary	per lb		to	40
Assafœtida	per lb		to	45
Benzoin, common	per lb		to	65
prime	per lb		to	85
white marbled	per lb		to	95
Copal, Accra	per lb		to	
Benguela	per lb		to	30
Kowrie	per lb		to	45
Damar, Batavia	per lb		to	60
Singapore	per lb		to	55
Elemi, Aromatic	per lb		to	55
Euphorbium	per lb		to	25
Galbanum	per lb		to	1 10
strained	per lb		to	1 25
Gedda	per lb		to	25
Guaiacum	per lb		to	44
strained	per lb		to	48
Kino	per lb		to	50
Mastic	per lb		to	4 25
Myrrh, Turkey, powdered	per lb		to	68
Olibanum	per lb		to	30
tears	per lb		to	40
Sandarac	per lb		to	65
Shellac, Campbell's D. C	per lb		to	50
Garnet	per lb		to	48
No. 2	per lb		to	45
Native	per lb		to	40
Senegal	per lb		to	50
Tragacanth, common	per lb		to	50
flake	per lb	1 30	to	1 50
flaky sorts	per lb		to	60
Harlem Oil, Dutch	per doz		to	50
Hoffman's Anodyne	per lb		to	45
Hydriodate Potash, Atkinson's	per lb		to	4 85
Conrad's	per lb		to	4 75
Hyoscyami Leaves	per lb		to	26
Hypophosphite Ammon.	per lb		to	3 50
Iron	per lb		to	8 00
Lime	per lb		to	3 25
Manganese	per oz		to	75
Potash	per lb		to	3 25
Soda	per lb		to	3 25
Iceland Moss	per lb		to	10
Indian Hemp, true	per lb		to	1 00
Insect Powder, true	per lb		to	1 00
Iodine, Resublimed	per lb		to	6 20
Crude, in bulk	per lb		to	6 25
Irish Moss	per lb		to	10
Iron, Alum	per lb		to	1 60
by Hydrogen	per lb		to	2 50
Carb. Proto	per lb		to	45
Precip	per lb		to	25
Citrate and Ammonia	per lb		to	1 40
Magnesia	per lb		to	1 30
Quiniæ	per oz		to	60
Strychnine	per lb	10 00	to	
Hypophosphite	per lb	8 00	to	
Iodide	per lb		to	8 00
Syrup	per lb		to	78
Lactate	per lb		to	3 25
Phosphate, Precipitate	per lb		to	67
Pyrophosphate	per lb		to	1 75
Syrup	per lb		to	65
Sesquichloride	per lb		to	1 45
Sol	per lb		to	60
Sesquinitrate	per lb		to	44
Subsulphate	per lb		to	1 70
Sulphate, pure	per lb		to	9
Exsiccat	per lb		to	17
Sulphuret	per lb		to	31⅓
Superphosphate Syrup	per lb		to	65
Tannate	per lb		to	6 00
India Ink	per lb		to	1 25
Isinglass, American	per lb		to	1 15
Russian, true	per lb		to	6 50
Juniper Berries	per lb		to	6
Juniper Tar Soap, Hazard & Caswell's	per doz		to	3 50

Lactucarium	per oz		to	75
Lead Acetate, pure	per lb		to	90
Licorice Paste, solid	per lb		to	40
Sicily	per lb		to	30
Calabria	per lb	43	to	44
Imitation	per lb		to	37
Barracco	per lb		to	44
P. S	per lb		to	44
Lime, Carbonate, Precipitate	per lb		to	22
Hypophosphite	per lb		to	3 75
Iodiae	per lb		to	8 50
Phosphate, Precipitate	per lb		to	40
Sulphite	per lb		to	31
Lime Juice	per gal		to	1 50
Lint, Taylor's	per lb		to	1 80
Lapis Calaminaris	per lb		to	8
Laurel Berries	per lb		to	12
Leaves	per lb		to	12
Liquid Styrax	per lb		to	60
Long Pepper	per lb		to	90
Lunar Caustic, pure	per oz		to	1 25
67 per cent., N. S	per oz		to	87
Lycopodium	per lb		to	60
Magnesia Carbonate	per lb		to	42
Calcined	per lb	95	to	1 20
ponderous	per lb		to	1 80
Citrate	per lb		to	1 75
Sulphite	per lb		to	1 20
Manganese, powdered	per lb		to	8
Saxony	per lb		to	12
Manna, small flake, '68	per lb		to	1 25
large flake, '67	per lb		to	2 00
sorts, new	per lb		to	1 00
Matico Leaves, true	per lb		to	50
Mercury	per lb		to	85
cum Creta	per lb		to	53
Magnesia	per lb		to	1 22
Cyanuret	per lb		to	5 80
Sulphuret	per lb		to	75
Mercurial Ointment (⅓M)	per lb		to	65
(⅓M)	per lb		to	58
Morphia Sulphate	per oz		to	9 75
Acetate	per oz		to	9 75
Muriate	per oz		to	9 75
Valerianate	per oz		to	11 00
Musk, true	per oz		to	16 00
in grain true	per oz		to	32 00
Nux Vomica	per lb		to	14
Oil, Amber, Crude	per lb		to	60
Almonds (Expressed) Allen's	per lb		to	72
Essential, Allen's	per lb		to	20 00
Anise	per lb		to	4 00
Bergamot	per lb		to	6 00
FF, new crop	per lb		to	6 00
Bergamot, Donner's	per lb		to	6 50
Bergamot,—Sanderson's	per lb		to	6 50
Cade	per lb		to	1 00
Cajeput	per lb		to	2 00
Camphor	per lb		to	1 75
Caraway	per lb		to	2 75
Seed	per lb		to	5 00
Cassia	per lb		to	3 75
Cinnamon, true	per oz		to	1 25
Citronella, prime	per lb		to	2 25
Winter's	per lb		to	2 50
Copaiva	per lb		to	2 85
Croton	per lb		to	3 50
Cubebs	per lb		to	4 00
Cummin	per lb		to	10 00
Fennel	per lb		to	3 00
Geranium	per lb	12 00	to	22 00
Chiris	per lb		to	14 00
Prepared	per lb		to	25 00
Turkish	per lb	14 00	to	18 00
Jessamine	per lb		to	3 50
Juniper	per lb		to	1 20
Berries, true	per lb		to	3 50
Lavender, Garden, forte	per lb		to	1 65
fine	per lb		to	1 85
Flowers, Chiris, No. 1	per lb		to	3 75
Lavender Spike	per lb		to	1 00
Laurel, Expressed	per lb		to	90
Lemon, Donner's	per lb		to	4 00
Lemon,—G. R. & Co's	per lb		to	4 00
—Sanderson's (new)	per lb		to	4 25
Lemongrass,—Winter's	per lb		to	4 00
Mace, Expressed	per lb		to	2 50
Marjoram	per lb		to	1 75
Myrrhane	per lb		to	2 00
Neroli Bigarade	per oz		to	4 75
Chiris	per oz		to	4 75
Petit Grain	per lb		to	23 00
Olive, pure	per gal		to	1 75
Marseilles, quarts	per box		to	5 50
pints	per box		to	6 00
Orange	per lb		to	3 50
Origanum	per lb	75	to	1 40
Patchouly	per oz		to	4 00
Pennyroyal	per lb		to	3 00
Peppermint, pure	per lb		to	3 00
Rhodium	per lb		to	10 00
Rose, Kissanlick	per oz		to	10 00
Rosemary, French	per lb		to	1 75
Trieste	per lb		to	1 15

Oil, Sabine, pure	per lb	to	1	70
Sassafras	per lb	to		90
Sesame, Salad, fine	per gallon	to	2	40
Spearmint	per lb	to	3	50
Spike	per lb	to		
Succinum, crude	per lb	to		60
rectified	per lb	60 to	1	25
Tanzy,—"Eastman's"	per lb	to	5	00
Thyme, white, pure	per lb	to	2	75
Valerian	per lb	to	18	00
Wintergreen	per lb	to	4	50
Wintergreen, Van Deusen Bros.	per lb	to	4	50
Wormwood	per lb	to	6	00
Wormseed, Western	per lb	to	2	50
Baltimore	per lb	to	3	25
Black Pepper	per lb	to	1	25
Cognac	per oz	to	3	50
Ergot	per oz	to		20
Opium	per lb	to	13	50
Orange Buds or Apples	per lb	to		18
Curacoa Ribs	per lb	to		38
Otto Rose, pure	per oz	to	10	00
commercial	per oz	to	7	00
Peppers, Zanzibar	per lb	to		35
Phosphorus	per lb	to	1	20
Amorphous	per lb	to	3	25
Piperin	per oz	to	1	50
Podophyllin	per oz	to		75
Poppy Heads	per lb	to		25
Potassa, Acetate	per lb	to		72
Bicarbonate	per lb	to		30
Carbonate	per lb	to		18
Caustic, common	per lb	to		60
white	per lb	to		85
Citrate	per lb	to	1	10
cum Calce	per lb	to		70
Hypophosphite	per lb	to	3	25
Permanganate, ordinary	per lb	to		75
Phosphate	per lb	to	2	75
Prussiate	per lb	to		44
Sulphate	per lb	to		15
Tartrate	per lb	to	1	00
Potassium	per oz	to	3	75
Bromide	per lb	to	1	50
Cyanide, fus.	per lb	to		75
gran	per lb	to	1	40
Iodide	per lb	to	4	75
Sulphuret	per lb	to		33
Quinine, Citrate, with Iron	per oz	to		60
Sulphate, American	per oz	to	2	40
French	per oz	to	2	80
Quassia, rasped	per lb	to		7
Red Chalk Fingers	per lb	6½ to		
Red Precipitate	per lb	to	1	10
Resin of Jalap, pure	per lb	to	28	00
Rochelle Salt	per lb	to		50
Roots, Aconite	per lb	to		24
Alkanet	per lb	17 to		
Althea	per lb	to		20
Angelica	per lb	to		30
Calamus	per lb	20 to		60
Colchicum	per lb	to		20
Colombo	per lb	to		20
Culveris	per lb	to		20
Dandelion	per lb	to		28
Galangal	per lb	to		10
Gentian	per lb	to		18
Ginger, Race, African	per lb	to		17
Jamaica, Bleached	per lb	to		28
Golden Seal	per lb	to		30
Hellebore black	per lb	to		16
white, powdered	per lb	to		28
Ipecacuanhæ	per lb	to	2	50
powdered	per lb	to	2	65
Jalap	per lb	to	1	65
powdered	per lb	to	1	80
Licorice	per lb	to		15
Mandrake	per lb	to		15
Orris, Florentine	per lb	to		20
Verona	per lb	to		15
Pink	per lb	to		30
Rhatany	per lb	to		28
Rhubarb, E. I	per lb	2 50 to	4	00
Turkey	per lb	to	20	00
Sarsaparilla, Honduras	per lb	to		54
Mexican	per lb	to		20
Turbeth	per lb	to		60
Valerian, English	per lb	to		50
Dutch	per lb	to		35
German	per lb	26 to		35
Vermont	per lb	to		35
Snake, Virginia	per lb	to		30
Seneca	per lb	to		50
Rose Leaves	per lb	to	2	50
Rosemary Leaves	per lb	to		12
Rubigo Ferri	per lb	to		10
Saffron, American, new	per lb	to	2	25
Spanish, true	per lb	to	16	00
Sago, Pearl	per lb	to		11
Salicin	per oz	to		55
Sal Acetoscella	per lb	to		50
Ammoniac	per lb	to		18
Soda, Newcastle	per lb	to		4
Santonine	per oz	to	1	00
Sassafras Bark	per lb	to		10

Scammony, virg., true	per lb	to	20	00
Seeds, Anise	per lb	to		24
star	per lb	to		60
Canary, Dutch	per bush	to	4	30
Smyrna	per bush	to	4	30
Cardamom, Malabar	per lb	to	4	25
Carui	per lb	to		22
Celery	per lb	to		70
Clover	per lb	to		16
Colchicum	per lb	to		20
Coriander	per lb	to		16
Cummin	per lb	30 to		35
Fennel	per lb	to		18
Fœnugreek	per lb	to		11
Hemp	per bush	2 25 to		
Linseed, American clean	per tierce	to	11	00
rough	per bush	to	2	50
Bombay (gold)	per bush	to	2	50
Calcutta (gold)	per bush	to	2	55
Mustard, brown	per lb	to		14
white	per lb	to		14
Rape	per bush	to	5	50
Timothy	per bush	to	5	00
Worm	per lb	to		28
Seidlitz Mixture	per lb	to		45
Senna, Tinnevelly	per lb	to		25
Alexandria	per lb	to		33
E. I.	per lb	to		25
Smalts, Blue	per lb	to		22
Snuff, Lorillard's Maccaboy	per lb	to		78
Coarse Rappee	per lb	to	1	00
Irish High Toast	per lb	to		85
Fresh Scotch	per lb	to		85
Soap, Castile, Mottled	per lb	to		16
White	per lb	to		25
floating	per lb	to		25
Low's Brown Windsor	per grs	to	14	00
Soda Acetate	per lb	to		80
Chlorate	per lb	to	2	00
Chloride, Liquor	per gal	to		45
Citrate	per lb	to	1	15
Hydrosulphate	per lb	to	1	05
Hypophosphite	per lb	to	3	50
Hyposulphite	per lb	to		9
Nitrate, pure	per lb	to		22
Phosphate	per lb	to		31
Pyrophosphate	per lb	to	1	25
Sulphite	per lb	to		32
Ash	per lb	to		4
Sodium	per oz	to		75
Iodide	per oz	to		50
Spirit Ammonia	per lb	to		40
Aromatic	per lb	to		40
Lavender	per lb	to		43
Nitre Dulc	per lb	37 to		40
Rosemary	per lb	to		45
Sponges, Bahama	per lb	to		90
Bathing, Formes	per lb	to	4	00
Coarse Brown	per lb	to		60
Fine, medium	per lb	6 00 to		
Surgeon's	per lb	4 00 to	7	00
Zimoca	per lb	2 00 to	3	00
Cup, Turkey	per lb	20 00 to	30	00
Trieste	per lb	4 50 to	13	00
Fine Toilet, bleached	per lb	12 00 to	15	00
Fine Trieste, small	per lb	4 00 to	4	50
Glove	per lb	to	1	50
Grass	per lb	to		25
Sheep's wool	per lb	1 60 to		
Sur Choix	per lb	to	5	50
Squills	per lb	to		12
St. John's Bread	per lb	to		8
Strontia, Muriate	per lb	to		30
Nitrate	per lb	to		30
Oxalate	per lb	to	1	30
Strychnia, Acetate	per oz	to	3	50
Citrate	per oz	to		70
Nitrate	per oz	to	3	50
Pure, crystallized	per oz	3 00 to	3	25
powdered	per oz	2 75 to	3	00
Sulphate	per oz	to	4	00
Valerianate	per oz	to	5	50
Styrax Calamita	per lb	to		55
Sugar of Lead	per lb	to		34
Sugar of Milk	per lb	to		58
Sulphur Sublime	per lb	6½ to		7
Tamarinds	per lb	to		10
Tannin	per lb	to	2	30
Taploca, East India, white	per lb	to		11
Pearl	per lb	to		15
Tartar Emetic, powdered	per lb	to		90
crystallized	per lb	to	1	10
Tin Foil, thin	per lb	to		45
French, No. 15	per lb	to		80
Tobacco	per lb	to		40
Tonqua Beans, Para	per lb	to		60
Angustora	per lb	to		80
Uva Ursi, American	per lb	to		12
French	per lb	to		13
Vanilla Beans, Bourbon	per lb	13 00 to	16	00
Mexican	per lb	15 00 to	18	00
Venice Turpentine	per lb	to		30
Veratria	per oz	to	4	25
Vitriol, Blue	per lb	to		14
Green	per lb	2½ to		3

Vitriol, White	per lb	to	9
Wax, White,—J. I. Elkens	per lb	to	75
No. 2	per lb	to	73
Phillips'	per lb	to	84
Yellow	per lb	to	48
White Wax,—Leonhardt's	per lb	to	90
Ockmid	per lb	to	85
Sun-bleached	per lb	to	76
White Precipitate	per lb	to	1 50
White Pepper	per lo	to	50
Wine, Colchicum Seeds	per lb	to	1 40
Wood Naphtha	per lb	to	95
Wormwood Herb	per lb	to	20
Yellow Bark	per lb	to	30
Dock	per lb	to	25
Zaffre	per lb	to	1 15
Zinc, Acetate	per lb	to	1 25
Chloride	per lb	to	1 80

DYES AND DYESTUFFS.

Aniline Blue	per lb	to	6 00
Red	per lb	to	6 00
Violet	per lb	to	6 00
Annatto	per lb	1 00 to	
Cochineal, Honduras	per lb	to	1 10
Mexican	per lb	to	1 05
Cudbear	per lb	25 to	40
Cutch, Pegue	per lb	to	15
Gambier	per lb	to	7
Indigo, Bengal, fine	per lb	to	3 00
good	per lb	2 50 to	2 75
middling	per lb	2 00 to	2 10
Madras, fine	per lb	to	1 70
ordinary	per lb	to	1 40
Kurpah	per lb	to	
Guatemala	per lb	to	2 00
Caraccas	per lb	to	1 65
Lac Dye, good to fine	per lb	55 to	60
Logwood, Campeachy	per lb	to	2¼
Honduras	per lb	to	2¾
Jamaica	per lb	to	2¾
Laguna	per lb	to	2
St. Domingo	per lb	to	2
Extract	per lb	14 to	18
" in bulk	per lb	14 to	15
Lima Wood (gold)	per bbl	to	70 00
Madder, Dutch	per lb	17 to	
French	per lb	to	18
Nutgalls, Blue, Aleppo	per lb	to	40
Orchi le	per lb	30 to	35
Persian Berries	per lb	50 to	55
Safflower	per lb	60 to	65
Sapanwood	per lb	to	15
Turmeric	per lb	to	15
Ultramarine	per lb	28 to	45
Woad	per lb	15 to	16

DRUGGISTS' GLASSWARE.

[PACKAGE PRICES.]

Green Bottles and vials	50	percentage	discount.
German Flint Bottles and vials	30	"	"
Flint Bottles and vials	25	"	"
Furniture Ware	10	"	"
Perfumer's Ware	25	"	"
Chemical Ware	net	"	"
Syringes	15	"	"
Homœopathic vials	15	"	"

NAVAL STORES.

Pitch, City	per bbl	to	4 00
Rosin, Extra Pale	per 280 lbs	8 00 to	
Pale	"	7 00 to	
No. 1	"	5 00 to	
No. 2	"	3 50 to	
Strained	"	3 50 to	
Common	"	to	3 00
Spirits, Turpentine (North Carolina)	per gal	to	50
Turpentine, Soft	per 280 lbs	to	6 00

OILS.

Linseed Oil, American	per gal	to	1 10
English	per gal	to	1 10
Palm Oil	per lb	to	16
Paraffine Lubricating Oil	per gal	to	40
Sperm, Crude	per gal	to	2 00
Sperm, Winter, bleached	per gal	to	2 10
Lard Oil Prime, City	per gal	to	1 65
Red Oil, City distilled	per gal	to	70
Red Oil, Saponified	per gal	to	78
Whale, Crude	per gal	to	1 10
Whale, Bleached, Winter	per gal	to	1 20

PAINTS (DRY).

Asphaltum, opt	per lb	10 to	12
Barytes, Foreign	per ton	to	45 00
Barytes, American	per lb	to	2
Black Lead	per lb	8 to	12
Black Ivory, drop, fair	per lb	10 to	18
good	per lb	18 to	20
best	per lb	24 to	28
Blue Celestial, good	per lb	to	14
Chinese	per lb	to	1 00
Prussian, fair to best	per lb	85 to	1 00
Ultramarine fair to best	per lb	28 to	45
Chalk, Lump	per lb	to	2¼
China Clay	per lb	to	2½
Chalk	per bbl	to	4 50
Green Paris, fair to best	per lb	35 to	50
Green Chrome, fair to best	per lb	33 to	42
Lamp Black—Coach Painter's—L. Martin & Co.'s.	per lb	23 to	25
Lamp Black, ordinary	per paper	8 to	12
Litharge, powdered, American & English	per lb	11 to	11½
Ochre, Yellow, French, dry	per lb	2½ to	4
Red Venetian	per lb	3½ to	5
Red Indian, fair to best	per lb	11 to	18
Red Lead, American	per lb	11 to	12
English	per lb	to	14
Rose Pink	per lb	to	20
Sienna, American	per lb	7 to	9
Italian, B'nt	per lb	18 to	22
Raw	per lb	15 to	20
Umber, Crude, Turkey	per lb	5 to	7
burnt	per lb	8 to	9
Tieman's Calif. Vermilion	per lb	to	1 00
Pure Carmine	per lb	to	14 00
Soluble Blue	per lb	to	1 25
Vermilion, English, pale	per lb	to	1 10
deep	per lb	to	1 10
American	per lb	to	35
Chinese	per lb	to	1 20
Trieste	per lb	to	1 20
White, China	per lb	to	22
Cremnitz	per lb	to	30
Lead, pure	per lb	13 to	14
good	per lb	9 to	11½
Paris	per lb	3½ to	4
Zinc, American	per lb	10 to	12½
Zinc, French	per lb	14 to	16
Whiting	per lb		3

PAINTS (IN OIL).

Black coach	per lb	28 to	30
Blue, Chinese	per lb	90 to	1 00
Prussian, fair to best	per lb	35 to	80
Brown, Van Dyke, fair to best	per lb	20 to	28
Dryer, Patent, American	per lb	12½ to	14
English	per lb	12½ to	15
Green, Chrome	per lb	18 to	27
Imperial	per lb	15 to	18
Paris	per lb	33 to	42
Verdigris	per lb	25 to	63
Putty, in bladders	per lb	to	5½
in bulk	per lb	to	5
Red Venetian, fair to best	per lb	8 to	16
Sienna, burnt, fair to best	per lb	22 to	35
White Lead, English, B. B	per lb	to	16
American, pure	per lb	13½ to	14
good	per lb	11 to	12½
fair	per lb	9 to	10
White Zinc, American	per lb	10 to	13
French	per lb	15 to	15½
Yellow Ochre	per lb	9 to	10
Chrome, fair to best	per lb	16 to	32

SPICES.

Cassia, in mats	per lb	to	64
Cloves	per lb	to	38
Ginger, Race, African	per lb	to	18
Mace	per lb	1 70 to	
Nutmegs, No. 1	per lb	to	1 40
Pepper	per lb	to	36
Pimento, Jamaica	per lb	to	33

WINDOW GLASS.

American Window—1st, 2d, 3d, and 4th qualities.

6	by	8	to	8	by	10	Per fifty feet	$ 6 25 to 3 75
8	by	11	to	10	by	15	"	6 75 to 4 75
11	by	14	to	12	by	18	"	7 50 to 5 50
13	by	16	to	16	by	24	"	8 50 to 6 00
18	by	22	to	18	by	30	"	10 00 to 7 00
20	by	30	to	24	by	30	"	12 50 to 8 00
24	by	31	to	24	by	36	"	14 00 to 9 00
25	by	36	to	26	by	40	"	16 00 to 10 00
28	by	40	to	30	by	48	"	18 00 to 14 00
24	by	54	to	32	by	56	"	20 50 to 16 00
32	by	58	to	34	by	60	"	24 00 to 18 00
34	by	62	to	40	by	60	"	26 00 to 21 00

The above is subject to a discount of 40 per cent.

French Window—1st, 2d, 3d, and 4th qualities. (Single thick.)

6	by	8	to	8	by	10	Per fifty feet	$ 6 25 to 4 75
18	by	11	to	10	by	15	"	6 75 to 5 00
11	by	14	to	12	by	18	"	7 50 to 5 50
13	by	18	to	16	by	24	"	8 50 to 6 00
23	by	22	to	18	by	30	"	20 00 to 7 00
20	by	30	to	24	by	30	"	12 00 to 8 00
24	by	31	to	24	by	36	"	14 00 to 9 00
25	by	36	to	30	by	48	"	16 00 to 10 00
28	by	40	to	30	by	48 (3 qlts)	"	18 00 to 14 00
34	by	54	to	32	by	56 (3 qlts)	"	20 50 to 16 00
32	by	56	to	36	by	60 (3 qlts)	"	24 00 to 18 00
34	by	52	to	40	by	60 (3 qlts)	"	26 00 to 21 00

Subject to a discount of 40 per cent. English sells at 10 per cent discount of the above rates.

THE CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

Volume VI. January, 1870.

ON THE

METHODS OF ANALYSIS

AND THE

COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

BY M. GASTON TISSANDIER.

(Continued from Am. Repr., Oct., 1869, page 211.)

Sulphates of Potash.

Almost all commercial sulphates of potash are obtained from beet-root salts, or by treating the ashes of sea-weed. All specimens, whatever their origin, may, however, be analysed in the following manner.

Mode of Analysis.—Weigh 25 grms. of the sulphate in question, and dissolve in distilled water; filter, to separate the insoluble substances, and wash the filter until the clear liquid, collected in a graduated measure, occupies the volume of 500 c.c.

Alkalimetric or Acidimetric Standard.—Plunge sensitive litmus paper into the solution, and ascertain whether it be alkaline or acid. In the first case, take the alkalimetric standard in 100 c.c. In the second, which is less frequent, obtain the acidimetric standard by means of a standard potash solution.

Sulphuric Acid.—The sulphuric acid is estimated in 10 c.c. of the solution (0·5 grm.), by means of chloride of barium.

Chlorine.—Determine the proportion of chlorine in 50 c.c. (2·5 grms.) by standard nitrate of silver.

Potassium.—To estimate this exactly, add to 10 c.c. of the solution a few drops of chlorhydric acid and of a standard solution of chloride of strontium, in such quantity that all the contained sulphuric acid may be precipitated in the state of sulphate of strontia. Let it stand for twelve hours; filter, and, after washing the precipitate, evaporate the filtered liquid almost to dryness. Add a slight excess of bichloride of platinum, and evaporate with the precipitated chloroplatinate of potash, which must be collected and weighed, as directed under the article "Salts."* The transformation of the sulphate into chloride by the chloride of strontium is indispensable, if an exact result be desired. Were the bichloride of platinum added directly to the solution of the sulphate, the potash would not be entirely precipitated; the precipitated chloroplatinate would contain, as has been already proved, a certain proportion of non-decomposed sulphate.

Moisture.—The salt is dried on a stove, at 110°, or in a platinum crucible.

Calculation of the Analysis.—The potassium found is converted into sulphate of potash, and it is seen by calculation if the quantity of sulphate of potash so formed contains the proportion of sulphuric acid found. If there is an excess of sulphuric acid, it is converted into sulphate of soda. If, on the other hand, the quantity of potassium is too considerable to saturate the whole of the sulphuric acid, the excess must be combined with chlorine and carbonic acid. Some sulphates contain chlorhydric acid. Its presence may be accounted for by the addition of sulphuric acid in the manufacture. The sulphuric acid is used to transform the carbonate of potash into sulphate, but, if added in too great excess, it will act upon the chloride of potassium, and give rise to an equivalent quantity of chlorhydric acid.

Composition of Commercial Sulphates.

I. *Sulphates obtained from Beet-root Salts.*

Matters estimated.	I	II.	III.	IV.	V.
Moisture.....	5·61	4·47	1·99	1·61	3·11
Insoluble matter.....	0·22	0·41	1·18	0·42	0·16
Chloride of potassium..	2·77	1·72	1·61	1·68	1·20
Sulphate of potash....	85·80	91·08	92·50	93·79	91·20
Carbonate of potash...	3·00	2·60	2·72	2·41	4·11
Carbonate of soda.....	2·60	—	—	—	—
Non-estimated and loss.	—	0·20	—	0·09	0·22
Total.....	100 00	100·00	100·00	100·00	100·00
				M. A. Lefebvre, Corbeheim, near Douai.	M. Dronlers, Aseq, nr. Lille.

II. *Sulphates obtained in the Manufacture of Iodine.*

Matters estimated.	I.	II.	III.	IV.	V.
Moisture.....	3·99	2·02	1·22	4·21	1·01
Insoluble matter.....	0·29	0·20	0·10	0·19	0·12
Chloride of sodium....	7·12	8·72	1·32	1·66	5·80
Sulphate of potash.....	75·84	75·12	75·62	77·00	82·69
Sulphate of soda	11·45	12·81	21·12	16·22	9·35
Carbonate of soda.....	0·80	0·71	0·62	0·72	1·03
Non-estimated and loss.	0·51	0·42	—	—	—
Total.....	100·00	100·00	100·00	100·00	100·00

Caustic Soda.

Specimens of commercial caustic soda generally present the appearance of greenish or yellowish masses, which must be quickly crushed into small fragments before analysis. For this purpose, it is best to employ a cast-iron mortar, perfectly clean, and previously warmed, in order that the soda may not absorb atmospheric moisture in any appreciable quantity during the crushing. Commercial caustic sodas always contain chloride of sodium, sulphate and carbonate of soda. The method by which the exact proportion of these constituent elements may be ascertained will now be shown.

Total Alkalimetric Standard.—Weigh 5 grms. of caustic soda quickly, and dissolve them in water. Take the alkalimetric standard in the cold, by means of ordinary standard sulphuric acid. The total standard of caustic soda is sometimes from 108 to 110°.

* Chemical News, vol. xx., p. 73 (*Am. Repr., Oct.* 1869, *p.* 207).

Estimation of Caustic Soda.—Weigh 5 grms. of caustic soda, and throw them into a stoppered flask containing about 400 c.c. of water: distilled water, previously boiled, to avoid its containing carbonic acid, is the best. When the soda has been dissolved by stirring, add an excess of chloride of barium, which will precipitate the sulphate of soda as sulphate of baryta, and the carbonate of soda as carbonate of baryta. The liquid thus formed must be filtered, care being taken to close the flask as much as possible, and to cover the top of the filtering funnel with a plate of glass, to avoid the action of the air. It is especially needful to place the funnel in a flat-bottomed flask, that the filtered liquid may not come in contact with the ambient air. Litmus is added to the filtered liquid, and the alkalimetric standard taken in the cold. The addition of normal sulphuric acid solution causes the formation of a precipitate of sulphate of baryta, due to the excess of chloride of barium; but this occurrence is of no importance. The number of divisions on the burette must be read at the exact moment when the last drop of standard liquid causes the solution to change from violet-blue to vinous-red. This number gives the standard of causticity, which, again, shows, by calculation, the quantity of caustic soda according to the following equation:—

$$\frac{\text{Standard or number of divisions on the burette}}{x} = \frac{49(SO^3,HO.)}{40(NaO,HO)}$$

The standard of causticity obtained, deducted from the total standard, gives the standard corresponding to the carbonate of soda, and, consequently, the proportion of the latter salt. To be more exact, this determination should be verified in the following manner.

Carbonate of Soda.—The filter containing the sulphate and carbonate of baryta will also serve to determine the quantity of carbonate of soda. Pour upon the filter water acidulated with pure chlorhydric acid, which will dissolve only the carbonate of baryta, without acting at all upon the sulphate. The filtered liquid contains, in the state of chloride of barium, all the baryta of the carbonate of baryta. Sulphuric acid is now added, and, after standing for twelve hours, the precipitated sulphate of baryta is weighed. The sulphate of baryta is transformed, by calculation, into carbonate of baryta, or, directly, by equivalents, into carbonate of soda; and thus the quantity of the latter salt contained in 5 grms. of caustic soda is ascertained.

Sulphate of Soda.—The amount of sulphuric acid in caustic soda is estimated in 5 grms. of the specimen under analysis, by means of chloride of barium (see article, "Salts," *ante*). If it be desired to omit this experiment, the filter used to obtain the standard of causticity may be immediately weighed, after rinsing with chlorhydric acid, to remove the carbonate of baryta. In this case, in order that the estimation may be exact, the precipitate of carbonate and sulphate of baryta must be allowed to stand for twelve hours.

Chloride of Sodium.—Weigh 2·5 grms. of caustic soda, and throw into a stoppered flask; dissolve it in water, acidulate with pure nitric acid, and estimate the chlorine with the standard nitrate of silver liquid (see article, "Salts," *ante*).

Moisture.—The moisture contained in caustic soda is estimated by operating in a silver crucible, which must have a cover. It is weighed empty, and again weighed with a small quantity of caustic soda. Heat is carefully applied to fuse the soda: great precaution must be used that the temperature may not be too much increased, in order to avoid projections. The action of too much heat would not only remove the moisture, but also part of the water in combination with the caustic soda, and the erroneous figure thus obtained would be, in that case, much too high. The caustic soda, once fused, is again weighed, and the three weights thus obtained are the bases of a simple calculation, which will give the quantity of humidity contained.

Calculation of the Analysis.—Some of our readers have asked for more ample details respecting the calculations necessitated by these modes of analysis. We will, therefore, re-produce an example of the analysis of caustic soda.

Direct Results of an Analysis of Caustic Soda.

Total standard, 109°.

Standard of causticity, 106°.

Number of divisions of the graduated burette of nitrate of silver (estimation made on 2·5 grms.), 101 divisions.

Weight of the sulphate of baryta in 5 grms., 0·195 grm.

By deducting the standard of causticity from the total standard, the standard of carbonate of soda is obtained. Say, $109 - 106 = 3$. To obtain the quantity of carbonate of soda corresponding to a standard of 3 degrees, it is only necessary to state the following equation:—

$$\frac{3}{x} = \frac{49(SO_3HO)}{53(CO_2NaO)}$$

Whence x (carbonate of soda) = 3·44 per cent.

The standard corresponding to the caustic soda is 106°. Consequently,

$$\frac{106}{x} = \frac{49(SO_3,HO)}{40(NaO,HO)}$$

will give x (hydrated caustic soda) = 86·53 per cent.

Commercial caustic soda is generally sold according to the quantity of anhydrous soda, NaO. To obtain NaO, state the equation—

$$\frac{86{\cdot}53}{x} = \frac{40(NaO,HO)}{31(NaO)}$$

Whence x (NaO) = 67·306 per cent.

For the chloride of sodium, the standard liquid containing nitrate of silver in such a quantity that one division corresponds to 1 milligramme of chlorine, state the equation—

$$\frac{101}{x} = \frac{35{\cdot}5(Cl)}{58{\cdot}5(NaCl)}$$

Whence $x = 1{\cdot}66$. But 2·5 grms. were operated upon; it is, therefore, necessary to multiply by 40 to obtain the quantity of chloride of sodium in hundredths.

$1{\cdot}66 \times 40 = 6{\cdot}64$, or ClNa = 6·64 per 100.

The sulphate of baryta, in 5 grms., weighs 0·195 grms. Consequently, the equation—

$$\frac{0{\cdot}195}{x} = \frac{116{\cdot}5(SO_3BaO)}{71(SO_3,NaO)}$$

will give $x = 0{\cdot}118 \times 20 = 2{\cdot}36$ of SO_3NaO per cent.

The analysis is thus formularised, after estimating the moisture, which we will suppose to exist in the specimen under analysis in the proportion of 1·02 per cent.

Moisture	1·02
Chloride of sodium	6·64
Sulphate of soda	2·37
Hydrated caustic soda	86·53
Carbonate of soda	3·44
	100·00

Oxide of sodium (NaO) = 67·306 per cent. We have omitted the calculation relative to the determination of the carbonate of soda by the carbonate of baryta, as it is sometimes unnecessary. Supposing the above analysis to have been scrupulously exact, the carbonate of baryta dissolved in pure chlorhydric acid, and precipitated as sulphate of baryta, would yield a weight of 0·379 of sulphate of baryta.

$$\frac{0{\cdot}379}{x} = \frac{116{\cdot}5(SO_3BaO)}{53(CO_2NaO)}$$

would give $x = 0{\cdot}172$ as the quantity of carbonate of soda contained in 5 grms. Multiplying by 20, the product would be—Carbonate of soda = 3·44 per 100.

Composition of Caustic Sodas.

Matter estimated.	I.	II.	III.	IV.	V.	VI.
Moisture	4·38	3·31	3·71	0·59	0·68	1·11
Chloride of sodium	11·32	12·22	3·90	7·23	6 89	5·60
Sulphate of soda	3·41	2·00	2·60	1·00	1·32	2·10
Carbonate of soda	5·58	9·82	3·69	3·45	3·68	5·48
Caustic soda (NaO,HO)	75·21	72·65	86·10	87·73	87·50	85·71
Total	100·00	100·00	100·00	100·00	100·00	100·00
Oxide of sodium (NaO) p. 100.	58·10	56·30	66·67	68·00	67·80	66·42
	French sodas.			English sodas.		

Sodas of a much poorer quality than those whose composition we have just given are occasionally to be met with. We subjoin an example of the analysis of one of these poorer caustic sodas. Caustic sodas are generally sold according to the quantity of anhydrous oxide of sodium (NaO); and the analyses are usually formularised in the above manner. It will be seen from the above figures that the products of English manufacture are much richer than the French. Some few French manufactures have already brought the production of caustic soda to perfection; but much progress still remains to be realised in France with respect to this manufacture.

Composition of Very Poor Caustic Soda.

Matter estimated.	I.	II.	III.
Moisture	1·01	0·92	0·99
Chloride of sodium	18·86	19·76	17·47
Sulphate of soda	7·42	3·09	2·36
Carbonate of soda	6·48	34·63	38·37
Hydrated caustic soda	66·12	41·60	40·81
Total	100·00	100·00	100·00
Oxide of sodium (NaO) per 100.	51·24	32·24	31·60

Salts of Soda.

Commercial salts, or carbonates of soda, are divided into hydrated salts and dry, or anhydrous salts. In most cases, the determination of the alkalimetric standard suffices to show the value of the product. The method of preparing the standard liquid sulphuric acid, which is very important, is as follows:—

Alkalimetric Standard Liquid.—The method which I prefer, and which may be called *méthode des tatonnements*, is as follows:—

Take pure commercial sulphuric acid, and weigh rather more than 100 grms. to the litre, in order to compensate for the proportion of water which is always contained in it. Let us suppose that 10 litres of standard liquid are required; a large bottle must first be gauged, by weighing into it 10 litres of distilled water, and marking the line made by the upper surface of the liquid with a stroke of a file. This done, half the water is poured away, and, to what remains, 1·200 grms. of pure commercial sulphuric acid are gradually added; the 10 litres are then filled up with distilled water. The liquid must now be stirred; and if the acid is of a good quality, the real composition of the normal liquid will be nearly arrived at, for the 200 grms. previously weighed will approximatively compensate the excess of water contained in the acid. The liquid will contain about 100 grms. of SO_3,HO per litre; but a mere approximation will not suffice, as extreme exactitude is indispensable. This first liquid must, therefore, be tested, in order to see whether it is too concentrated or too weak; that is, whether water or sulphuric acid must be added.

The test is easily effected with dry and pure carbonate of soda, which should estimate 92·40°, if the liquid is quite correct. It is a good plan to prepare the carbonate of soda one's self, in the following manner:—Fill, with bicarbonate of soda, a funnel, the lower part of which is provided with a plug of amianthus; wash the salt with water, so as to purify it and to eliminate the alkaline sulphates and chlorides with which it is mixed. When the rinsing-water no longer contains either chlorine or sulphuric acid, the bicarbonate of soda is pure; it must then be crystallised and calcined, when carbonate of soda is produced. To obtain still more exactitude, this is again dissolved, crystallised, and calcined, and it will then be perfectly pure and dry, and should estimate 92·40°.

In testing the alkalimetric liquid, it is a good plan to heat the carbonate of soda before weighing, and even to calcine it slightly, in order to separate the water which it may have absorbed; 5 grms. are then weighed, and their standard taken. If this proves to be too high—say, for instance, 94°—the liquid is too weak, and a small quantity of sulphuric acid must be added. By thus feeling the way, as it were, adding now more acid and now more water, a liquid is easily obtained which will give, in combination with the dry, pure carbonate of soda, a normal standard of 92·40°.

In order to avoid error, it is indispensable that the alkalimetric burettes employed should be scrupulously exact; they should, therefore, be tried—the best way of doing this is by means of the balance. A small precipitating vessel should be tared upon the pan of a sensitive balance, and distilled water poured into it from a burette. If the burette is correct, the volume of water contained between ten divisions, or 5 c.c., must be 5 grms.

Still greater exactitude may be obtained by testing the standard acid with protoxide of lead as follows:—Weigh 20 grs. of pure litharge, and heat them, in a small capsule, on a Gay-Lussac stove at 110°, until their weight no longer decreases; pour in 10 c.c. of the alkalimetric standard liquid, which, if correct, should contain 1 decigrm. of sulphuric acid, SO_3,HO; evaporate the whole to dryness on the stove, and weigh again. The increase of weight should be exactly 0·0816 grs., corresponding to the quantity of SO_3 contained in 0·1 gr. of SO_3,HO.

Too many precautions cannot be used in order

to obtain a well-prepared normal liquid, which is of the utmost importance in working analyses. Some chemists are in the habit of estimating the sulphuric acid contained in 5 c.c. of the liquid; for this purpose, chloride of barium is used; and a well-performed experiment on a correct liquid should yield 0·2378 of sulphate of baryta, corresponding to 0·1 gr. of SO_3,HO.

Analysis of Dry Soda-Salts.—We will say nothing concerning hydrated carbonates of soda, which often contain more than 60 per cent of water; it is only necessary to remark that the alkalimetric standard is very important, as it often exposes the fraud of dealers. The method which we are about to describe, for analysing dry salts of soda, may also be applied to hydrated salts.

Weigh 25 grms. of the salt to be tested, dissolve in water, and filter the insoluble substances upon a filter placed above a test-glass gauged to ½ a litre. The liquid ½ litre is divided in the following manner:—

Remove 100 c.c., corresponding to 5 grms., to ascertain the alkalimetrical standard. By stating the equation—

$$\text{Standard, or number of divisions on the burette} = \frac{49(SO_3HO)}{53(CO^2NaO)}$$

the carbonate of soda per cent is obtained. Deduct 50 c.c., to estimate the chlorine, which is transformed into chloride of sodium, and 100 c.c., to estimate the sulphuric acid, which is changed into sulphate of soda. The estimation of the moisture is effected separately in a platinum crucible. Those who wish for a description of the process are referred to former chapters.

Composition of Salts of Soda.

Substances estimated.	I.	II.	III.	IV.	V.
Moisture	2·22	3·11	1·15	1·co	0·40
Insoluble matter	0·12	0·22	0·o8	—	0·06
Chloride of sodium	12·48	6·41	3·28	2·11	0·99
Sulphate of soda	8·51	3·25	2·15	1·50	0·35
Carbonate of soda	76·67	87·01	92·34	95·39	98·20
Total	100·00	100·co	100·00	100·00	100·00

Salts of soda derived from the refining of beet-root salts always contain a small quantity of potash, which may be easily estimated by means of bichloride of platinum.

Estimation of Caustic-Soda.—Salts of soda sometimes contain caustic soda, the proportion of which may be determined in the following way:—

Pulverise part of the specimen finely, throw it into a stoppered flask, into which have been previously poured 100 c.c. of alcohol at a temperature of 40°, and stir vigorously for 10 minutes. The alcohol does not dissolve the soda, while at the same time it absorbs the whole of the caustic soda. Filter under a bell-glass, in order to avoid evaporation of the alcohol; collect 50 c.c. of the liquid, which will correspond to 5 grms. of salt, saturate it with the alkalimetric liquid in the cold, adding water and a few drops of sensitive litmus, and the *standard of causticity* will be obtained. This standard allows the calculation of the corresponding quantity of caustic soda, NaO,HO, deducted from the total standard; the difference given will be the standard corresponding to the carbonate of soda.

Composition of Salts of Soda containing Caustic Soda.

Substances estimated.	I.	II.	III.	IV.
Moisture	2·10	1·50	2·48	1·38
Insoluble matter	0·12	0·11	0·21	0·09
Chloride of sodium	4·32	2·43	3·50	4·11
Sulphate of soda	8·88	1·62	2·15	2·50
Carbonate of soda	82·47	88·09	84·54	81·67
Caustic soda	2·11	6·25	7·12	10·25
	100·00	100·00	100·00	100·co

Detection of Iron and Sulphides.—Salts of soda destined for the manufacture of glass should be free from iron (which colours the glass), and from alkaline sulphides. Iron may be detected by means of sulphydrate of ammonia, or, which is better, sulphocyanide of potassium, the most sensitive reagent of that metal. If the solution of the salt under examination should contain traces of iron, it will assume a red hue under the influence of some drops of this reagent poured into an acidified liquid. To detect sulphides, boil the salt of soda to be tested in a flask containing sulphuric acid diluted with water. The liberated sulphydric acid may be known by its smell, or by the influence which it exerts upon paper previously soaked in acetate of lead.

Nitrates of Soda.

The analysis of nitrates of soda requires great care; for the amount of nitrate contained in them is determined by difference.

Estimation of Moisture.—Heat 5 grms. of the specimen on the stove at 120° until they no longer lose weight. The method of the closed tube, previously described, may also be employed.

Estimation of Chlorine.—Nitrates of soda do not usually contain more than from 1 to 1·60 per cent of chloride of sodium, therefore the estimation must be made upon 10 grms. with the silver liquid.

Estimation of Insoluble Substances.—Dissolve 25 grms. of nitrate of soda in water, and separate the insoluble matters by filtration. They, however, occur in but small proportions.

Estimation of Sulphuric Acid.—This is estimated on 25 grms. of nitrate of soda. The filtered liquid is now used for this purpose, having previously served to determine the quantity of insoluble substances. The sulphuric acid is precipitated as sulphate of baryta, and filtered after standing twelve hours.

Subjoined is an example of the composition of some commercial nitrates of soda, and of the way in which it is usual to formularise the analytical results obtained.

Loss per cent.	I.	II.	III.	IV.
Moisture	0·98	1·11	1.42	1·68
Insoluble matters	0·07	0·12	0·16	0·15
Chloride of sodium	0·99	1·10	1·41	1·60
Sulphate of soda	0·18	0·20	0·22	0·25
Total loss	2·22	2·53	3·21	3·68
Nitrate of soda	97·78	97·47	96·79	96·32
Total	100·00	100·00	100·00	100·00

The quantity of water contained in nitrates of soda rarely exceeds from 2 to 2·50 per cent. The proportion of nitrate of soda varies between 95 and 99 per cent.

(To be continued.)

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Am. Repr., Dec., 1869, p. 331).

The microscopist, in the course of his studies, will find a very large class of substances for which the processes described in the preceding chapter are of no avail, owing to the impossibility of drying them without materially affecting their structure. The preservation of such substances has always been a matter of some trouble; and beginners are frequently deterred from attempting the processes of fluid mounting by supposing that the difficulties are of an insurmountable kind.

There is also a prejudice against objects mounted in fluid, owing to their supposed want of durability. There is, no doubt, some ground for this objection if the ordinary fluid-mounted objects only are considered. These are of necessity manufactured cheaply and in large numbers, and but little care can be bestowed upon their preparation. But, if the cabinets of our best manipulators are examined, the evidence will be found rather in favour of than against fluid mounting, provided care be taken to adopt the best processes, and carry them out carefully; the causes of failure being rather attributable to bad workmanship than to defects in the mode of preparation. Instances are on record of objects mounted in fluid as long ago as twenty years being still in good preservation.

The subject naturally divides itself into two parts; the processes connected with the enclosing of the object in its cell, and the consideration of the nature of the fluid media employed as preservatives.

The object to be mounted in fluid will nearly always require some previous preparation, excepting in those cases where it is free from included air, and the fluids contained in its tissues are readily miscible with the preservative employed. This preparation consists in keeping the tissues required for preservation immersed either in the fluid in which they are to be mounted, or some other which is capable of combining with it without injurious chemical change. This soaking will occasionally occupy a considerable time; but it may be materially expedited by making use of the air-pump, which will ensure the saturation of the tissue, and assist in the removal of air that may be held within it. The process is exactly the same as that adopted on the large scale for the preservation of railway-sleepers, by impregnating them with creosote; and, in another operation (one that more closely approaches the subject under consideration), Manfield's patent for making pickles, in which the vegetables to be treated are saturated in a few minutes with vinegar, by being submitted to its action in a vessel from which the air has been exhausted; a process which took so long a time in the ordinary way, that manufacturers, to save the loss of capital involved in using vinegar, employed brine, which was afterwards removed by strong acetic acid, greatly to the detriment of the resulting manufacture, both as to flavour and wholesomeness. This is now obviated by the new process, the pickles produced by which closely resemble those made at home.

Although the air-pump is useful where substances peculiarly liable to retain air (such as large anatomical preparations) are being operated upon, its use can generally be dispensed with for ordinary purposes, a prolonged soaking being sufficient in most cases.

In mounting an object in fluid, a cell of suitable size and depth is to be selected, and care taken that it is properly cleaned. It is then filled with the mounting fluid, and should be rather over than under filled. The object is now placed in the cell, unless circumstances have rendered it advisable that this should be done previously. The preparation, at this stage, should be carefully examined, with a view to the detection of air-bubbles. They are especially liable to adhere to the lower part of the cell, where it joins the glass slide. They are best dislodged by drawing the point of a needle round the interior of the cell. Floating bubbles may be broken or removed by lightly touching with a pointed fragment of blotting-paper.

The cover glass is to be placed upon the cell as directed in balsam mounting—letting one edge touch the cell first; and, as in that process care was taken to keep everything dry, in fluid mounting we should adopt the opposite course of treatment. To secure the adhesion of the mounting fluid to the cover, and lessen the chance of including an air-bubble, it is well to moisten the cover by breathing on it just before placing it on the cell.

The surplus fluid is best removed, in the first instance, by drawing it off with a curved and sharp-pointed pipette, made in the form of an ordinary blow-pipe. The use of this contrivance will generally allow the floating cover to be brought in contact with the top of the cell without the risk of flooding its upper surface, which is nearly sure to take place when the cover is pressed down suddenly, and will give trouble to remove when viscid fluids like glycerine and oil are used. When as much of the fluid is removed as can be conveniently taken up with the pipette, the rest is absorbed by the careful use of fragments of blotting-paper. Care must be taken not to carry this process too far, as, if too much of the fluid is absorbed, an air-bubble may enter, which will necessitate the removal of the cover and a repetition of the operation. The moisture being cleaned off the outside, the cell is ready to receive its first coat of varnish, which is to be applied with a small brush, and care should be taken to fill the angle at the contact of the cover and cell, and to include in the ring of varnish a small portion of the edge of the cover. This first coat of varnish must be put on by hand, as the adhesion of the cover is too slight to bear the action of the turn-table, which machine, however, may be employed with advantage in laying on the second and subsequent coats, as, by its use, greater neatness and rapidity are attained than are possible by painting on the varnish by hand.

The best and most durable cement for securing the covers of objects mounted in fluid is the varnish known as japan gold-size, the principal constituent of which is boiled linseed-oil. It is easily obtained at any varnish shop. It is best kept for use in the collapsible tubes recommended for holding Canada balsam. If kept in a bottle, it absorbs air, thickens, and loses, to some extent, its drying properties. This varnish is remarkable for its elasticity and toughness when dry, which may readily be proved by scraping a portion, which will be found to come away in shreds instead of chipping, as many other varnishes do. Glycerine and castor-oil, both valuable mounting fluids, have the unfortunate property of dissolving gold-size; therefore, in using these media, it is necessary, before putting on the coatings of gold-size, to apply two or three coatings of

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

the liquid glue previously mentioned. This varnish is impervious to oil and glycerine, but is too brittle when dry to be trusted alone. The liquid glue will be found effectually to protect the gold-size, with which the preparation is to be finished. This precaution is not required when using media which do not injuriously affect gold-size, such as weak alcohol and water, saline solutions, camphor and creosote water, &c.

Some microscopists make use of asphalte or Brunswick black for securing the cover. They have the fault of being brittle, which, however, is said by Dr. Beale to be remedied by the admixture of a small portion of solution of india-rubber in naphtha. The author's experience of this cement is rather unfavourable. It may, however, be owing to having used a bad specimen ; as it is probable that many kinds of Brunswick black are manufactured, and they are likely to vary extremely in quality. However, as gold-size is so reliable a cement, and so easily procured, there is no occasion to risk the use of a varnish whose properties are somewhat uncertain.

Should the mounting fluid be one which leaves a deposit on drying (which is the case with saline solutions), or be difficult to clean off (like glycerine), after the first coat of varnish is dry, the slide should be washed, either by holding under a partially-open tap, or by means of the ordinary wash-bottle. If this precaution is not taken, the adhesion of the cement is rendered uncertain, and neglect of this matter is a not unfrequent cause of leakage. If necessary, this washing must be repeated after the second coat of varnish. With oil, a somewhat different treatment is needed. The cleaning is best effected with a camels'-hair brush, charged with turpentine or benzol.

The slide should not be put away in the cabinet until it has received at least six or eight coats of gold-size. No varnish should be laid on thickly, otherwise it is liable to remain fluid in the interior, although apparently hard outside.

In commencing the practice of fluid mounting, it will be advisable for the student to make his first trials with some such fluid as camphor-water or diluted alcohol, as the difficulties of cleaning, &c., are much less than with saline solutions or glycerine.

A very ingenious process of fluid mounting forms the subject of a communication by Mr. T. C. White to the Quekett Microscopical Club (*Journal of the Quekett Microscopical Club*, vol. i., p. 147). He forms a cell with a thick varnish, made by dissolving gum damar in benzol. This is done by holding a brush charged with it against a slide while revolving on the turn-table. The cell will be ready in a few minutes, as it is used while half dry. The fluid and object are placed in the cell, and the cover glass put on, and pressed down into the cement, which adheres most tenaciously to wet glass. The surplus fluid is to be removed with blotting-paper, which may be used with the greatest freedom, as the glass is held very firmly by the damar varnish, another coat of which is applied by means of the turn-table, and the slide is completed. It would no doubt be more secure if finished with a few coats of gold-size. This process can only be used by those who are somewhat expert, as, should the first attempt fail, the cover cannot be removed and the process repeated. It is a very expeditious mode of mounting, and is likely, in some cases, to prove of great value. Mr. White states that he has had slides mounted for two years which are still perfectly sound and free from air-bubbles. The solution of damar may also be used as a very efficient substitute for the mixture of balsam and benzol. It is, like most varnishes, rather troublesome to make, as, owing to the impurities usually contained in the gum, the varnish requires straining; a somewhat difficult matter with so volatile a solvent as benzol.

The durability of objects, however mounted, is much influenced by the manner of storing them. Racked boxes and drawers are the worst possible receptacles, as from the vertical position of the slides they are liable to serious injury, those in fluid being likely to become leaky, and the balsam specimen sliding down, frequently, cover and all. Arrangements should be made for keeping the objects flat, which is now always done in well-constructed cabinets; it is also a great advantage to be able to see every slide, which is impossible in a racked box, and often causes much loss of time in searching for an object. For the convenience of those for whom the usual cabinets are too costly, Mr. Piper has invented some very ingenious trays, in which slides are placed horizontally; besides the merit of cheapness, they have the advantage of being extremely convenient. Five or six of these trays, with a mill-board at the top and bottom, may be fastened together with a couple of India-rubber rings, and any vacant shelf-room utilised for the storage of objects; a similar bundle of two or three trays is very convenient for carrying a small selection of objects in the pocket. Dr. Carpenter has used these trays placed in wooden cases made to resemble books, a very convenient way when bookshelves are vacant to receive them.

The chief difficulty of fluid-mounting will be found not to consist so much in the mechanical process of closing the object perfectly in its cell, as in the selection of a fluid suitable for its preservation.

A fluid which may be considered as a perfect medium—that is, one capable of preserving substances for an unlimited period without change, is at present unknown, and it is more than doubtful whether the discovery of such a fluid would be altogether an advantage, as use is frequently made of what some may consider the defects of preservative fluids, the alterations they induce in tissues submitted to their action often revealing facts of great importance. Some media are valuable, because they soak into tissues and render them transparent; this is the case to such an extent with glycerine, that Dr. Beale very appropriately calls it "The Canada balsam of moist tissues." Others are used for quite the opposite purpose, because they induce opacity, and very frequently do so partially, bringing out details somewhat in the same manner as is done by the colouring of a map, and which, without such aid, would be very imperfectly distinguished. Others are slightly corrosive, and clear away parts wished to be got rid of for the sake of bringing others more prominently into view.

In mentioning some of the very numerous media which have been used for mounting, the results can only be stated generally, and no fixed set of rules can be given, as the whole subject is at present in too imperfect a state. Much good might be done by observers mounting a series of the same object in different media, carefully labelling each slide with the date of mounting and the nature of the medium employed, and from time to time noticing and recording the result.

One of the great difficulties affecting the mounting of objects in fluid, arises from endosomotic action. When two fluids of different densities are separated by a permeable membrane, they will pass through and mix at very unequal rates. Supposing some dense fluid, like glycerine, inclosed in a bladder and immersed in water, the water would flow into the bladder faster than the glycerine made its way out; the result would be the expansion of the bladder. This is called endosmosis: the reverse action is known as exosmosis. With a view to observing practically the result of these actions, the student is recommended to obtain a specimen of some fresh-water conferva, such as are abundant in nearly every pond or aquarium. A portion of this conferva should be placed on a slide in a drop of water, covered with a thin glass, and examined with a power of fifty or sixty diameters. When the appearance of the plant is well impressed on the mind, remove the slide from the microscope, take off the cover-glass from the object, and with a piece of blotting-paper drain off (not blot up) as much of the water as possible. Now cover the conferva with some strong glycerine, replace the cover quickly, and examine without loss of time under the microscope, and notice the change that has taken place. The fluid contents of the conferva cells have suddenly emptied themselves into the surrounding glycerine, leaving the whole plant in a shrivelled and contracted state; in many cases the cells will be found to be ruptured, but those which have escaped injury will after a time expand and resume their natural appearance. In observing, advantage is sometimes taken of induced endosmosis, the tissues ruptured by this means often revealing points of structural detail difficult or impossible of demonstration by dissection. Endosomotic action may be prevented by introducing objects which contain light fluids very gradually into denser ones; for instance, an object should be passed from water into weak glycerine and then after a time into stronger, till at last it might be placed in glycerine of full strength without any contraction taking place. The same phenomena takes place if marine plants are immersed in fresh water. This may be familiar to some who have attempted to wash delicate sea weeds, such as *Griffithsia setacea*, in fresh water, the result being that the cells burst and stain the mounting paper; this may be prevented by washing in sea water, or water having gum or sugar dissolved in it, so that its specific gravity approaches that of sea water. An ingenious application of the principle of gradually increasing the specific gravity of the mounting fluid with a view to the prevention of endosmosis, will be found in the method known as Hantzsch's. The fluid consists of three parts alcohol, two of distilled water, and one of glycerine (Price's), all by measure. This medium is principally employed in mounting *Algæ*. The specimen is placed in the cell with this fluid and the cover put on, but not cemented, so as to allow evaporation to take place; the waste is supplied from time to time, until at last the cell contains nearly pure glycerine; it is then to be cemented as before described. The fluid is of very nearly the same specific gravity as water, so little or no endosomotic action takes place on the immersion of the specimen; and as the evaporation process increases the strength of the solution very gradually, the most delicate tissues can be eventually mounted in strong glycerine; doubtless this principle would answer equally well with a solution of chloride of calcium, a very valuable medium for certain preparations. Much valuable information respecting the collection and preparation of *Algæ*, will be found in "The Collector's Handy Book of Algæ," by Rev. W. W. Spicer, from which the above process is taken.

Taking the preservative fluids in groups, the simplest consist of water, either alone or in combination with some antiseptic substances.

Distilled water alone is capable of preserving such objects as the *Desmidiæ* and other *Algæ* in tolerable perfection as to form, although with more or less loss of colour and alteration of the disposition of the endochrome or cell contents. Confervæ are very apt to grow in slides in which distilled water is used; this is best prevented by saturating the water with camphor or creosote.

Camphor water is made by placing a lump of camphor in a bottle of distilled water, and allowing it to remain a few days; the water will then be found to smell very strongly, although the quantity dissolved is exceedingly small. Such portion as may be required for use is to be filtered and kept in a small bottle; the store bottle is to be filled up from time to time with distilled water. This fluid may be used with advantage in making and diluting all the preservative fluids mentioned in these papers instead of pure distilled water, unless an indication to the contrary is given in the formula. It is capable of preserving animal tissues as well as vegetable, but with the fault of most watery liquids, that it is apt in time to induce a granulous texture in objects of this kind mounted in it.

Creosote water is made in a nearly similar manner; a few drops of creosote are poured on a quantity of precipitated chalk, and the whole shaken up in a bottle of distilled water. When the chalk has settled, the clear liquid may be poured off and filtered as required for use; the preservative properties of this and also of a very diluted solution of carbolic acid closely resemble those of camphor water. For another use of carbolic acid see paper by Dr. Bastian, before quoted (Chemical News, vol. xx., p. 96).

Alcohol diluted with water, in various proportions, is much used for the preservation of large anatomical specimens; portions of injected tissue to be viewed as opaque objects keep very well in it, also vegetable structures where loss of colour is not objectionable. The striated structure of muscular fibre is well shown when this medium is employed; a piece of cooked meat will do to experiment upon. The fibres should be well separated with the needles before the cell is closed. Many other preparations are used for the preservation of objects.

Thwaite's Fluid.—Water, 16 ozs.; alcohol, 1 oz.; creosote and chalk, as in creosote water. Pour the creosote on the chalk as before, add the alcohol, stir up the whole, and add the water very gradually; allow the mixture to stand a few days, and then filter. Dr. Beale found that this solution was liable to become thick after a time, and gives the following substitute in his "How to Work with the Microscope:"—"Creosote, 3 drachms; wood naphtha, 6 ounces; distilled water, 64 ounces; chalk, as much as may be necessary. Mix first the naphtha and creosote; then add as much prepared chalk as may be sufficient to form a smooth, thick paste; afterwards add very gradually a small quantity of the water, which must be well mixed with the other ingredients in a mortar. Add two or three small lumps of camphor, and allow the mixture to stand in a lightly-covered vessel for a fortnight or

three weeks, with occasional stirring. The almost clear supernatant fluid may then be poured off and filtered if necessary; it should be kept in well corked or stoppered bottles." Dr. Beale states that he has had large preparations preserved in this fluid for more than twelve years, and that it is still bright and colourless.

Fluids are filtered by being strained through a conical bag made of a circular piece of porous paper manufactured for the purpose, folded in the usual manner, and supported in a glass or porcelain funnel of suitable dimensions. If the proper filtering paper is not at hand, white blotting paper will answer the purpose.

Chloride of Calcium (a saturated solution in camphor water).—For making this solution, the pure fused salt should be used, and not the common kind used for drying; it should be carefully filtered before use; it can be diluted to any extent with camphor water. The saturated solution is an extremely valuable preservative fluid; it soaks into objects, rendering them transparent, but rather less so than strong glycerine; it has the advantage, also, of not injuring calcareous tissues. Insects, viz., fleas and lice, mounted whole in this medium, with little or no compression, show the tracheal system and many of the internal organs remarkably well when properly illuminated, and are still in perfect condition; date of mounting, 1866. Flax, hemp, and other similar fibres display their structure far better in this than in any other medium, the secondary deposits being very clearly brought out.

Diluted Solution.—One part of saturated solution to ten of camphor water, answers well for the preservation of the fresh-water *Algæ;* the green colour is better preserved by it than it is in any other fluid.

Chloride of Sodium (common table salt).—A saturated solution seems to preserve *Entomostraca* very well indeed; it induces a slight degree of opacity, which is sometimes an advantage. Specimens of *Daphnia pulex* (water fleas) mounted in it in September, 1866, show much of the internal structure; the eyes and bundle of optic nerves are in very perfect condition. This solution is of value from its being readily procured anywhere, and a supply of specimens which would otherwise be lost may be preserved in it. Sea water impregnated with camphor or creosote will preserve various delicate marine animals and plants extremely well and without injury from endosmosis; by taking proper precautions they may be gradually transferred, if necessary, to strong glycerine.

Solution of arsenious acid in water has been used both alone and in combination with glycerine for the preservation of objects; the latter mixture has answered very well in re-mounting a series of injected preparations, which are now, after a period of about six years, in perfect condition. The quantity of arsenic capable of being dissolved in water is extremely small; solutions of arsenic, unless saturated with camphor, are especially liable to confervoid growths, a rather unexpected phenomenon in so poisonous a fluid.

Many other saline solutions will be found in microscopical works. The best have been given above; a larger selection would tend rather to confuse than assist the beginner.

Glycerine is one of the most valuable materials ever added to the resources of the microscopist. We are indebted to the late Mr. Robert Warrington for the application of this fluid to microscopical purposes. It is obtained as a waste product in the manufacture of soap, and lead plaster. The quality of the glycerine from these sources is very inferior, being both weak and impure. The best is that made by Price's Patent Candle Company, and obtained by a distillation process. This is much purer and stronger than the common kind, having a specific gravity of about 1240, and is the only kind fit for use by the microscopist. The properties of glycerine as a means of giving transparency to an object have already been mentioned. It is a thick, syrupy, and highly refractive fluid, nearly colourless, and intensely but pleasantly sweet. Although made from fat, it is not at all greasy, but freely miscible with water and many other fluids; it is also a solvent for a great number of substances. Its action upon varnish has already been alluded to. It is stated by Dr. Carpenter that it dissolves carbonate of lime readily, and quite destroyed the calcareous skeleton of certain *Echinodermata* mounted in it. He suggests that, when used for such purposes, it should be saturated with carbonate of lime by being kept in a bottle with some fragments of marble ("Microscope and its Revelations," fourth edition, p. 222). One of the advantages of glycerine is that it never dries; so that an object can be placed in it, covered with a glass, and left uncemented, without fear of evaporation for any length of time, and afterwards mounted permanently, if desired. Owing to its free miscibility with other substances, it forms many very valuable compounds, some of which will presently be described. A very full account of its use in delicate physiological investigations is given in Dr. Beale's "How to Work with the Microscope," a book of the greatest service to all intending to study the particular subjects upon which it treats. It is by the use of glycerine that Dr. Beal has succeeded in carrying on his elaborate investigations of the ultimate structure of nerve tissue under excessively high powers; and his processes afford a remarkable illustration of the support afforded to a delicate tissue by immersion in a fluid of extreme density, the manipulation of tender substances being comparatively easy in glycerine, when, in water or alcohol it would have been impossible.

Strong glycerine preserves nearly every kind of object, whether animal or vegetable, with great perfection, and is, perhaps, the nearest approach to an universal mounting-fluid yet known. Insects and other objects may be put into a bottle of glycerine, and left until wanted; they are even better after a year or two's soaking. Objects mounted in glycerine generally improve after a time, details often being visible which were not seen immediately after mounting. The introduction of the binocular microscope has very much influenced the style of mounting objects to be viewed with low and medium powers. For this purpose, it will be found advantageous to mount the object with little or no compression. Of course, for examination with high powers, thin and compressed specimens are absolutely necessary (see author's paper, *Monthly Microscopical Journal*, vol. i., p. 331).

Glycerine can be diluted to any extent, either with camphor or creosote water, should it be desired to obtain a less refractive fluid, and one which does not render objects so transparent as pure glycerine; sometimes a portion of alcohol may be added with advantage. This compounding of media is one of the greatest arts in fluid mounting, and can only be acquired by experience, as, at present, no definite directions can be given. Diluted fluids, as a general rule, make animal tissues more granulous and opaque after a time than

the strong, dense ones. The author possesses an instance of a difficult mounting accomplished almost by chance. The subject was the Medusoid embryo of *Hydra tuba*, which he had been observing at a friend's house. Thinking it a pity to lose a specimen then seen for the first time, he took the object home alive in its cell of sea-water, and then determined to attempt its permanent preservation. The course of operation was as follows:—The slide was placed in a saucer, which was quickly filled with strong alcohol (about 60 over proof). This fortunately killed the animal so suddenly that it was but little contracted. A mounting-fluid, consisting of glycerine, alcohol, and sea-water, was then extemporised, and the object mounted. It is still in good preservation, although somewhat opaque. It was mounted in February, 1862. This is given as an instance of the kind of practice occasionally needed in cases of emergency, and where the tact acquired by experience may be turned to good account.

It is occasionally convenient to make use of a medium which, while it is fluid at the time the object is mounted, will ultimately harden, and preserve the object from injury from being shaken or moved. Such media are especially useful for mounting *Diatomaceæ* attached to other *Algæ*. There are many compounds of this nature, some of the best of which are largely composed of glycerine.

The earliest of these was that known as *Deane's gelatine*. It is composed of—Gelatine, 1 oz.; water 4 ozs.; honey 5 ozs.; creosote, 6 drops; alcohol, ½ oz. The gelatine is to be soaked in the water until quite soft; the honey, heated to the boiling point, is to be added. The whole is then to be boiled, and, when it has cooled a little, the creosote and alcohol, mixed together, are to be added, and the whole filtered through fine flannel.

Glycerine jelly consists of gelatine soaked in camphor-water until it swells and becomes soft. The surplus water is to be poured off, and the jelly strained, and, if necessary, clarified after the manner of confectioners with white of egg. To every ounce by measure of this jelly add 1 drachm of alcohol and 6 drachms of Price's glycerine.

Both these media are used by melting the composition by placing the bottle in hot water, just as glue is melted. It is then used almost precisely in the same way as Canada balsam, taking the precaution to prepare the object by a previous soaking. Thin objects do not require a cell. When the gelatine has hardened sufficiently, the surplus portion is scraped off, and the slide cleaned. It should then be secured with a coat or two of liquid-glue, followed by several coats of gold-size, as in moist preparations.

A very useful medium of nearly similar properties is made according to the following formula of Mr. Farrants:—Picked gum arabic, 4 parts by weight; water, 4 parts; glycerine, 2 parts. The mixture is to be made cold, and, if necessary, strained through fine muslin. It is to be used in the same manner as the foregoing gelatinous preparations, only without heat, which renders it particularly fit for objects that will not bear the slight increase of temperature required to liquefy gelatine.

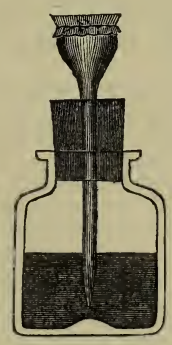
The action of all the above media is nearly similar to that of slightly diluted glycerine, excepting that, when set, they keep the object fixed in the position in which it was mounted.

Strong syrup is capable of preserving animal and vegetable tissues, but is, under some conditions, liable to crystallise. The best proof of the perfect manner in which vegetable substances are preserved is given in the condition of preserved fruits, which are in an extremely favourable condition for microscopical examination. The samples of jam, &c., examined by Dr. Hassall, and reported upon in his "Food and its Adulterations," were probably among the tissues most easily identified, owing to their perfect condition.

Castor-oil will be found an excellent mounting-fluid; it penetrates, and gives considerable transparency, and keeps the object well and for a long period. It is particularly successful with parasitic insects; these may be placed in a bottle of castor-oil, and kept until required for mounting. As castor-oil is so readily procured, being in every medicine-chest, and to be obtained at any little village shop, it is a very useful medium for those who may wish to preserve insects, &c., captured while travelling, as they need no attention after they are immersed in it. Should it be desired to mount the objects ultimately in some other medium, the oil can easily be removed by soaking in benzol.

Mounting-fluids which are in frequent use are best kept in a small, wide-mouthed bottle, through the cork of which is passed a pipette, surmounted by a funnel at its upper extremity, upon which is stretched a piece of sheet-india-rubber (Fig. 18). By this contrivance,

Fig. 18.



a small quantity of fluid can be taken up, and delivered, drop by drop, upon the slide. Where mounting-fluids are continually required, as in pathological laboratories, Dr. Beale has contrived a little fountain on the principle of the wash-bottle, which answers admirably for a supply of any kind of fluid in drops; but, for the occasional use of the student, the pipette-bottle is to be preferred.

Closely connected with fluid-mounting is the process of staining tissues. This is used for two widely different purposes. The first for rendering very transparent bodies more easily visible; this is easily done by immersion in magenta, diluted as the particular case may require. The other for more clearly defining certain parts, or parts in a particular state; this is done by using staining fluids which act unequally. For instance, if it be desired to stain the nuclei of cells, the following solution of carmine, described by Dr. Beale in "How to Work with the Microscope," and reprinted here by his kind permission, will answer admirably:—"Carmine, 10 grains; strong liquor ammoniæ, ½ drachm; Price's glycerine, 2 ozs.; distilled water, 2 ozs.; alcohol, ½ oz. The carmine, in small fragments, is to be placed in a test-tube, and the ammonia added to it. By agitation, and with the aid of the heat of a spirit lamp, the carmine is soon dissolved. The ammoniacal

solution is to be boiled for a few seconds, and then allowed to cool. After the lapse of an hour, much of the excess of ammonia will have escaped. The glycerine and water may then be added, and the whole passed through a filter or allowed to stand for some time, and the perfectly clear supernatant fluid poured off and kept for use. This solution will keep for months, but sometimes a little carmine is deposited, owing to the escape of ammonia, in which case one or two drops of liquor ammoniæ to four ounces of solution may be added." For further information relative to the application of the staining process, and the observations to be carried out by its means, the student is referred to Dr. Beale's work.

Solutions of chloride of gold and nitrate of silver may also be employed to advantage (see paper by Dr. Bastian before quoted; T. Dwight, *Monthly Microscopical Journal*, vol. ii., p. 45).

Next in importance to the possession of a good instrument, is the having a good supply of light, and knowing how to make proper use of it. The sources of light available for the microscopist's use have already been described; the ways of utilising the light so obtained, and the instrumental appliances for directing it, form the subject of this chapter.

The natural division of illuminators is into two classes—those which act above the stage of the microscope, and send light down upon an object; and those which are placed below the stage, and send light through it.

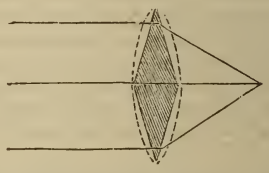
Of instruments of the first class, one—the *condensing lens*—is usually supplied with every microscope, however plainly equipped. This lens enables light to be concentrated upon the object on the stage; either a double-convex or a plano-convex lens may be used for this purpose. If the first is employed, no particular attention is required beyond placing it at such a distance above, and on one side of the stage, that the light falls at a suitable angle, and that the object is in or near the focus; should a plano-convex lens be used, its position is of some importance, as, if it is turned the wrong way, its spherical aberration is greatly increased, and, of course, a corresponding amount of light lost. The plano-convex lens, or bull's-eye, when used to concentrate parallel rays—daylight, for instance—or divergent rays, such as those proceeding from a lamp, should always be placed with its convex side turned towards the source of light, as the spherical aberration is then much less than it would be when placed in the contrary direction; if the lens is to be used for rendering parallel the divergent rays of a lamp, then the bull's-eye is to be placed in the opposite position, with its flat side turned to the lamp, and at a distance from the flame equal to its focal length. Parallel rays are required when using some of the illuminating apparatus presently to be described.

Very much may be done with the condensing lens, if skilfully used; especial care is required that it causes the light to fall on the object in the right direction, as the appearance of the surface of many substances is very different when illuminated from opposite sides; the student should, therefore, never be contented with a single observation of a strange substance, but should change its position, so that it may be viewed with the light falling upon it in as many directions as possible. This is most easily effected by causing the object to rotate while the light is directed upon it, so that the alteration caused by every change of position can be easily noted. The necessary movement is now very generally fitted, even to the stages of small instruments, and persons about to procure a microscope would do well to incur the small extra cost of this useful addition.

The light obtained by the condensing lens may be greatly augmented by using two, one of larger dimensions than the other, the light being brought to a certain degree of convergence by the first and larger lens, and afterwards concentrated by passing through the smaller one, which should be so placed as to intercept the cone of light from the large lens at the place where it is of its own diameter.

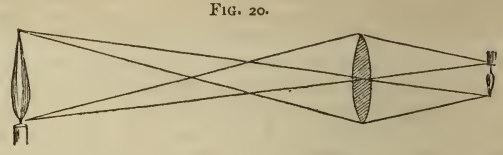
Most of the other illuminators of this class act by reflection, mirrors of various forms being employed. The optical properties of concave mirrors resemble, in many points, those of convex lenses; they cause parallel rays to converge (Fig. 19), render divergent rays par-

Fig. 19.



allel, or convergent, and also form images (Fig. 20). Microscopes and telescopes can be constructed with

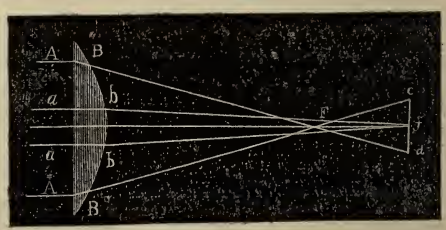
Fig. 20.



mirrors or specula, instead of object-glasses; this principle is still in use as regards telescopes of large dimensions, as the difficulties of making object-glasses of large diameter are very great; the largest yet accomplished is only 25 inches, while the largest speculum (that of the late Lord Rosse) is 6 feet in diameter.

Professor Amici constructed a very efficient compound microscope, having an elliptical speculum in place of an object-glass; the plan, however, was abandoned on the introduction of the achromatic principle, although its performances were very superior to those of the non-achromatic instrument.* Concave mirrors, when formed of segments of spheres, are liable to spherical aberration, just as lenses are (Fig. 21); therefore, when it is required to render

Fig. 21.

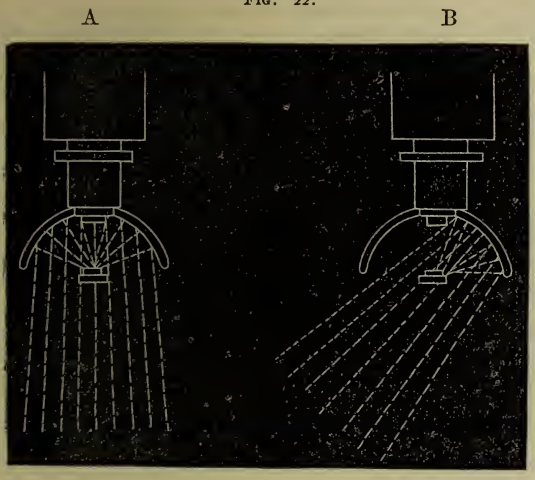


divergent rays parallel, or bring parallel rays to a focus,

* One of these instruments has recently been presented to the Roya Microscopical Society; there are also several old and curious microscopes in the Society's collection.

it is necessary that the figure of the mirror should be that of a parabola. Speeula of this form are used in astronomical telescopes, the reflectors of lighthouses on the catoptrie principle, and in some instruments presently to be described. The parabolic curve differs from the circle principally in being flatter at the edges and deeper at the centre. Reflecting instruments are entirely free from chromatie aberration. The oldest of the reflecting illuminators is that known, from the name of its inventor, as the *Lieberkuhn* (Fig. 22); it

Fig. 22.



consists of a spherical silver mirror, perforated, to allow it to slide over the setting of the object-glass, and is so adjusted that the focus of the speculum is coincident with the working distance of the object-glass. The objeet is illuminated by light reflected through the hole in the stage by means of the mirror; this is again reflected, but in a very convergent state, upon the objeet, which will be intensely illuminated if the speculum is well adjusted to focus and properly supplied with light.

It is necessary to place beneath the object a black stop of sufficient size to fill the field of the object-glass, otherwise the light from beneath entering the microscope will cause a disagreeable amount of fog and indistinctness. The best kind of background eonsists of a dark well or little cup of proper size painted black inside, and placed below the object; a patch of blaek paper or paint will, however, answer the purpose. Beck's disc holder (Fig. 23) is particularly useful for objects to be examined by the aid of the lieberkuhn, as it forms its own black stop. Its late talented inventor

Fig. 23.

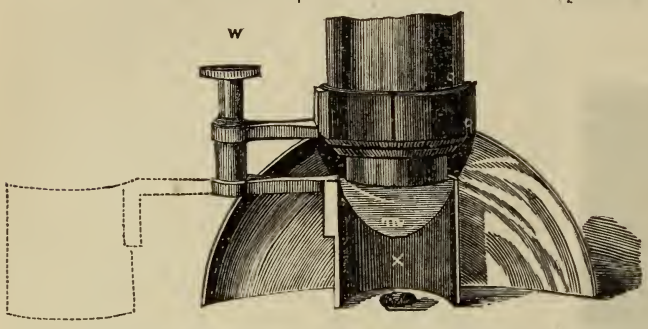
was very expert in the employment of this kind of illumination. The defects of the lieberkuhn are that its light is nearly vertieal, and therefore, like the tropical mid-day sun, casts little or no shadow; this, however, may be remedied, to some extent, by turning the mirror aside and using the light from only one-half of the speculum (Fig. 22, B); also it requires the object and its mounting to be small enough to allow the free passage of the light around it from the mirror.

These defects caused the lieberkuhn to fall somewhat into disuse; the introduction of the binocular microscope, however, caused it again to be employed, as it was found very suitable for the peculiar class of opaque objeets which are so well displayed in relief by its stereoscopie power. It has, however, again been nearly superseded by an improved form, which has all its advantages besides some peculiar to itself. This improved instrument, which is known as the *parabolic lieberkuhn* (Fig. 24), is another of the numerous contrivances of the late Richard Beck, and was described by him in the *Microscopical Quarterly Journal* for 1865 (vol. xiii., p. 116). It consists of a portion of a silvered paraboloid, which is attached by a ring to the setting of the object-glass, so that it has some range of adjustment like the ordinary lieberkuhn, but instead of the light being direeted upon it from below through the hole in the stage, it is supplied from one side, which allows this form of lieberkuhn to be used with objects mounted in the ordinary way. It is necessary when lamp light is used that the rays should be rendered parallel by placing a condensing lens between the lamp and the reflector, as before mentioned. As there is a very large reflecting surface, and from the parabolic figure of the mirror no spherical aberration, the amount of light concentrated upon the object is much greater than could be obtained from the ordinary spherical lieberkuhn. It has also the advantage of refleeting rays from one side only and of considerable obliquity. These properties make it the most perfect illuminator yet produced for viewing opaque objects by reflected light. Its effect is almost like that of brilliant sunshine, lighting up the interior of every eavity, and yet, at the same time, casting strong shadows and defining minute portions of structure in a manner hitherto unapproached. The paraboloid as usually constructed is adapted for use with objectives of from 2 inches to two-thirds focus. A very ingenious mounting, allowing a very large range of adjustment to be given to the paraboloid, has been contrived by Mr. Crouch, who uses a short adapter screwed into the body of the microscope as a support to the reflector and its fittings, which consists of sliding tubes and ball-and-socket joints, by means of which it can be placed in extremely varied positions, and is adapted for use with any microscope or object-glass fitted with the universal screw. It must be borne in mind that these advantages are gained at the expense of removing the object-glass a small distance, viz., the length of the adapter from the Wenham prism, while, to obtain the best possible definition, the back lens of the objective cannot approach the prism too closely; therefore in making choice between the two forms of mounting the paraboloid, the student must consider whether convenience with a trifling loss of definition will suit him, or whether the most perfect definition is required with the trifling inconvenience attending the ordinary form.

An addition to the parabolic lieberkuhn, consisting of a small plane mirror (Fig. 24, *m*) inclined at an angle of 45°, which is so fitted that it can be brought into the proper position for reflecting light vertically upon the object, by means of the milled head, w, has been made by Messrs. Beck, at the suggestion of Mr. Sorby, who required this contrivance for viewing the polished surfaces of specimens of iron and steel. When light is

directed obliquely upon a highly polished surface, it is reflected at an angle equal to the angle of incidence, none of it enters the microscope, and the surface appears intensely black, but when illuminated vertically, all its structural peculiarities are at once brought into view. For such researches the plane speculum is indispensable, and its adaptation in no way interferes with the ordinary use of the paraboloid.

Fig. 24.



The late Richard Beck made a small paraboloid, adapted for use with the 4-10th objective. This the author had an opportunity of working with, and, although only in experimental condition, was much pleased with its performance. It was returned after trial, but has not at present been produced for sale by Messrs. Beck, probably on account of its value not being generally known. From its very short focus, it requires much more careful fitting to the objective it is intended to be used with than the larger paraboloid; but when carefully executed, it works quite as well with its own object-glass as the one above mentioned with the lower powers. The author, however, possesses one which was made for him by Mr. Bailey, of 162, Fenchurch Street, which performs admirably, and is executed in this optician's usual careful manner. The parabolic lieberkuhn is of great value with $\frac{1}{2}$ inch and 4-10th objectives, as these glasses allow but little space between the front glass and the object for illumination with the condensing lens.

A very efficient illuminator was, until recently, much in use; it is known as the *side reflector*, and consists of an oblong silvered mirror of spherical figure. It has ball-and-socket and sliding adjustments, and is attached either to the stand of the microscope or else is mounted upon an independent support; it is placed on one side of the instrument, and the light directed upon it from the opposite side. The speculum is then adjusted until the object is properly illuminated. It has, however, been superseded by the parabolic lieberkuhn before described.

(To be continued.)

VOLUMETRIC SOLUTIONS FROM WHICH THE PERCENTAGES MAY BE READ OFF IN THE NUMBER OF VOLUMES REQUIRED.

BY WATSON SMITH, F.C.S.

The great advantage to commercial analysts of a method of constructing volumetric solutions from which the percentages may be read off in the number of volumes of such solutions required, or ascertained by a very simple calculation which can be mentally performed with ease, is, I think, palpable. The following is an outline, with examples of the methods of calculation required in titrating these solutions:—

For the sake of brevity, let x = weight of body taken, in which it is required to find the percentage of l; let n = number of volumes of solution required, and *p.c.* stand for percentage.

1st. Solutions from which the *p.c.* may be read off directly, or *p.c.* = n.

The solution is so made that the weight of l, to which each 100 volumes is equivalent, = x; or, in other words, the solution is so made that 100 vols. thereof shall just be equivalent to the amount of l in the weight, x, of the body, supposing it to contain 100 *p.c.* of l.

From the foregoing, it will be seen that, for each solution, x must be a constant weight, in order that the percentages may be obtained in each special manner.

Now, by way of verification, let x = 10.

a. Then each volume of solution must be equivalent to 0·1 l or 100 vols. = 10 l.

And, say, 55 vols. of solution have been required in an experiment, then the body contains $\frac{55 \times 0{\cdot}1 \times 100}{10} = 55$ *p.c.* of l.

β. Let x = 4·4. Each volume of solution must = 0·044 l (100 vols. = 4·4 l); and, say 55 vols. of solution have been required, the body contains $\frac{55 \times 0{\cdot}044 \times 100}{4{\cdot}4}$ = 55 *p.c.* of l.

As practical examples, take the following:—

a. It is required that the *p.c.* of NH_3 in a sample of ammonium sulphate be ascertained. Let 5 grms. = x (see Chemical News, Notes and Queries, vol. xx., p. 168; *Am. Repr., Dec.* '69, *page* 391; then the acid solution (say hydrochloric) must be made so that each c.c. is equivalent to 0·05 grm. of NH_3=0·091 grm. Na_2O.

This is done by weighing out $\frac{106 \times 2{\cdot}5}{132} = 2{\cdot}008$ grms. of sodic carbonate (pure and freshly-ignited), and making the acid so that 50 c.c. thereof are just sufficient to neutralise this 2·008 grms.

A *sodic-carbonate* solution must now be made, exactly equivalent to the acid solution; *i.e.*, 100 c.c. must contain $\frac{5 \times 106}{132} = 4{\cdot}015$ grms. of Na_2CO_3, or 40·15 grms. per litre. Therefore, 40·15 grms. of pure freshly-ignited sodic carbonate must be weighed out, dissolved in pure distilled water, and diluted to 1 litre.

Now, supposing the NH_3 has been distilled off, from the weight of sulphate taken, into 24 c.c. of the HCl solution, and 3·5 c.c. of sodic carbonate solution have been required to neutralise the excess of HCl, then 24 — 3·5, = 20·5 *p.c.* of NH_3 are contained in the sample of sulphate.

b. Again, a convenient "test acid" for estimating the *p.c.* of soda in samples of sodic carbonates and hydrates may be made as follows:—Dilute a quantity of sulphuric acid with about its own bulk of water, and let stand till cold; then further dilute till a Twaddell's hydrometer marks in it 10¾° (which indicates about the sp. gr. of the required acid). 5 grms. of pure freshly-ignited sodic carbonate are now weighed out, and the acid is so adjusted that 58·5 c.c. are just re-

quired for neutralisation. (N.B. Pure Na_2CO_3 contains 58·5 Na_2O.)

2nd. Solutions of decimal strength, or in which $p.c. = n \times 0{\cdot}1$.

Where the reagent from which the volumetric solution is to be made is expensive, and the percentages happen to be low, a more dilute liquor is used, and thus a smaller weight, to represent x, is to be taken. Thus, for example, a convenient silver solution, for the determination of the *p.c.* of NaCl in samples of salt-cake, may be made as follows:—

Let $x = 2$ grms. Make the nitrate of silver solution of such strength that each c.c. = 0·002 grm. of NaCl—*i.e.*, equivalent to 2 grms. of NaCl per litre of silver solution, or 0·2 grm. of NaCl per 100 c.c. Now 2 grms. of NaCl are equivalent to $\frac{2 \times 170}{58{\cdot}5} = 5{\cdot}81$ grms. of $AgNO_3$; therefore weigh out 5·81 grms. of $Ag\,NO_3$, dissolve in pure distilled water, and dilute to 1 litre.

From the preceding, it is seen that the silver solution is so made that 100 vols. thereof shall be equivalent to the amount of $l \times 0{\cdot}1$ in the weight, x, taken (supposing x to contain 100 per cent of l); so that n vols. being required, $p.c. = n \times 0{\cdot}1$.

3rd. Solutions of half strength are, also, often useful where the *p.c.* of *l.* is usually very large, and but a small quantity of the body can be conveniently taken (to represent x), for various reasons. In this case $p.c. = n \times 0{\cdot}5$.

For a solution of the above strength, 100 vols. of such solution must be equivalent to the amount, $l \times 0{\cdot}5$, in the weight, x, taken (supposing x to contain 100 *p.c.* of l); so that if $x = 1$ grm., and $n = 30$ c.c. $30 \times 0{\cdot}5$, or $\frac{30}{2}$ $= 15$ *p.c.* of l, are contained in the body experimented upon.

Of course, by varying the weight, x, in a particular manner, the same solution may be actually altered from decimal to half strength, or from half to full strength, &c.; thus, from decimal to half strength, take 1-5th x; from half strength to full strength, take $\frac{1}{2}\,x$; and from decimal to full strength, take 1-10= x.

The burette, which is used for titrating each solution, should be always used for that particular solution, as burettes which are graduated to hold equal volumes are very often found erroneous.

ECLIPSE OBSERVATIONS.

Among the various observations made at the last eclipse, none exceed in interest those of Professor C. A. Young, of Dartmouth College, Hanover, New Hampshire. We quote from the *Journal of the Franklin Institute* an abstract of this gentleman's report:—

The observer was a member of the party under the direction of Professor J. H. C. Coffin, of the Nautical Almanac Office, stationed at Burlington, Iowa.

The instrument employed was a spectroscope with 5 prisms of 45° each, having faces 2¼ by 3¼ inches; the collimator and telescope had apertures of 2¼ inches, with a focal length of 17. These were connected with a "comet seeker" of 4 in. aperture and 30 in. focus, used with an eye-piece, and giving an image of the sun, 2½ inches in diameter, on the slit of the spectroscope. A graduated screen at the slit determined positions of points on the sun's limb, and a wire micrometer measured the positions of spectrum lines. The whole was mounted equatorially with slow motion screws.

Protuberances were noted before the eclipse at + 85° to 100°, large and not very bright; at + 146°, small and bright. The photographs show another at 155°, which escaped notice; also at — 70° to 80° low, but pretty bright; and at — 130°, very large and bright, the principal one. Angles are reckoned on the sun's limb from the North point, + towards the East, — towards the West.

The first contact was observed by watching the gradual shortening and final extinction of the bright line, c, in the spectrum of the prominence, which happened to be at the point of contact. The moon's approach was perceived full thirty seconds before its actual appulse; the observation was perfectly easy, and the time determined is certainly to be relied on within half a second, and probably much less. The presence of a prominence at the point of contact is not essential to the success of the method, as there is everywhere on the sun's limb sufficient depth of chromosphere to answer the purpose.

It is proposed to apply the spectroscope to observations both of the external and internal contacts at the next transit of Venus.

During the totality, the following nine bright lines were observed in the spectrum, viz., c dazzling in brilliance; 1017·5 (near D, the numbers refer to Kirchhoff's scale), very bright, but not equal to c; 1250±20, very faint, position only estimated; 1350±20, like the preceding; 1474 (a little below E) conspicuous, but not more than half as bright as 1017·5; F, next to c in brightness; 2602±2, a little fainter than 1474, position determined by micrometrical reference to the next; 2796, a little below G, the well-known H.γ line in brightness between 1017·5 and 1474; and finally H, or Hδ, somewhat brighter than 1474. B was not seen, it is supposed on account of a mistake in carrying that portion of the spectrum through the field while there was no prominence on the slit.

*The line 1474 was recognised as belonging to the spectrum of corona, in the first place, by its extending clear across the spectrum, while 1017 did not, and then by its remaining visible when the slit was moved away from the protuberance, while the other lines (c and 1017) disappeared. The impression of the observer is that faint lines 1250 and 1350 behaved in the same manner, but his recollection as to this point is not very certain.

These three lines, 1250, 1350, and 1474, coincide far within the probable errors of observation with three lines observed by Professor Winlock in the spectrum of the Aurora Borealis. The two first are not accurately enough determined, in position, to allow much stress to be put upon any apparent coincidences on their part, but the last is perfectly well known, and its exact agreement throughout with one of the fainter lines

* A careful examination of the photographs of the prominences on the eastern limb of the sun, upon which the slit of the spectroscope was directed during the first half of totality, somewhat diminishes my confidence in the conclusion of the text, as to the nature of these three lines. I think it absolutely certain that they do not belong to the spectrum of the brilliant portion of the prominences; but the photograph shows, in addition, an extensive nebulosity surrounding the nuclei with a pretty definite boundary of its own; this nebulosity is best seen in No. 2 of the totality pictures taken at Burlington. Now, it is possible that these lines may belong to this nebulosity, and not to the corona proper; for I cannot recall, with certainty, whether the 1474 line retained its brilliance at any considerable distance from the prominences. My impression is that it did, and that the text is correct, but do not wish to be too positive. The eclipse of December, 1870, will decide, of course.

of the Aurora, when combined with the general appearance of the Corona and other considerations, give a good deal of probability to the conjecture that our Aurora Borealis and the Solar Corona are identical phenomena.

The line 1474 is given by both Kirchhoff and Angström (not by Huggins, who, however, omits many faint lines), as belonging to the iron spectrum, and this suggests the inquiry whether we are to admit the existence of iron in the auroral heights of our atmosphere, or are to account for this line in the iron spectrum by some unknown substance of gaseous nature.

The corona showed, also, a faint continuous spectrum without any trace of dark lines. The light of this faint spectrum, tested by a tourmaline held in the hand next the eye, was strongly polarised in a plane passing through the sun's centre. As the direction of the spectroscope slit was nearly radial, it is not impossible that Professor Pickering may be right in explaining this polarisation as caused by the successive refractions through the prisms.

Professor Young's remarks, in his note on the lines in the corona or glow, are curiously in accordance with those of Dr. B. A. Gould, given in the same journal as an extract from a letter to its editor, Professor Henry Morton, who organised and conducted the largest and most successful photographic party during the late eclipse.

Photographs of the Chromosphere.

In a letter just received from Dr. B. A. Gould, we find the following interesting paragraphs, which, with his permission, we extract:—

"An examination of the beautiful photographs made at Burlington and Ottumwa, by the sections of your party in charge of Professors Mayer and Himes, and a comparison of them with my sketches of the corona, have led me to the conviction that the radiance around the moon, in the pictures made during totality, is not the corona at all, but is actually the image of what Lockyer has called the chromosphere.

"This interesting fact is indicated by many different considerations. The directions of maximum radiance do not coincide with those of the great beams of the corona; they remained constant while the latter were variable; there is a diameter, approximately corresponding to the solar axis, near the extremities of which the radiance upon the photographs is a minimum, whereas the coronal beams in these directions were especially marked during a great part of the total obscuration. The coronal beams stood in no apparent relation to the protuberances, whereas the aureole, seen upon the photographs, is most marked in their immediate vicinity. Indeed, the great protuberance, at 230° to 245°, seems to have formed a southern limit to the radiance on the western side, while a sharp northern limit is seen on all the photographs at about 350°, the intermediate arc being thickly studded with protuberances, which the moon displayed at the close of totality. The exquisite masses of flocculent light on the following limb are upon the two sides of that curious prominence at 93°, which at first resembled an ear of corn, as you have said, but which in the latter pictures, after it had been more occulted, and its southern branch thus rendered more conspicuous, was like a pair of antelope horns, to which some observers compared it. Whatever of this aureole is shown upon the photographs, was occulted or displayed by the lunar motion, precisely as the protuberances were. The variations in the form of the corona, on the other hand, did not seem to be dependent in any degree upon the moon's motion.

"The singular and elegant structural indications, in the special aggregations of light on the eastern side, may be of high value in guiding to a farther knowledge of the chromosphere. They are manifest in all the photographs by your parties which I have seen, but are especially marked in those of shortest exposure, such as the first one at Ottumwa. In some of the later views they may be detected on the other side of the sun, though less distinct. But the very irregular and jagged outline of the chromosphere, as described by Janssen and Lockyer, is exhibited in perfection.

"This happy result is clearly attributable to the relative shortness of the time of exposure by which the highly photographic rays of the chromosphere have depicted themselves, without obliteration by the mass of coronal light which veiled them from the eye. Let us hope that at the next total eclipse some impressions may be taken with an exposure not exceeding a single second, as you have suggested. The inference seems warrantable that in this way, better than in any other, the internal structure of the protuberances may be exhibited, though other phenomena may fail to record themselves.

"You will observe that some of the brighter, petal-like flocculi of light have produced apparent indentations in the moon's limb at their base, like those at the basis of the protuberances. These indentations are evidently due to specular reflection from the moon's surface, as I stated to the American Association at Salem last month. Had any doubt existed in my mind previously it would have been removed by an inspection of the photographs.

"I shall send the substance of these remarks to Professor Coffin, as a sort of postscript to my report, which contains only the results of personal observations at the time."

SIMPLE APPARATUS

FOR

RAPID VAPOURISATION AT LIMITED HEAT,

UNDER REDUCED PRESSURE, WITHOUT USE OF A PUMP.

BY A. B. PRESCOTT,

Assistant Prof. of Chemistry, &c., University of Michigan, U. S.

The pump is not always at hand; its use is forbidden for transmission of corrosive vapours; and, moreover, the removal of liquids, in form of vapour, against the weight of the air by muscular power is liable to "exhaust" the operator more effectively than it does the material. I desire to ask attention to some uses of ordinary distilling apparatus, for the production and maintenance of approximate vacuum over liquids during their vapourisation, in cases where the heat of 120° to 150° F. may be applied.

It is necessary that the distilling apparatus be made capable of air-tight closure, and that the air be removed from it to begin with. Then the degree of exhaustion in the apparatus is in direct ratio to the rapidity of condensation of the vapour produced. And the rapidity

of condensation is only limited by the degree and extent of refrigeration employed, with a given extent of evaporating surface at a stated temperature. The air in the apparatus, to begin with, may be expelled through a suitable aperture by steam, which may be generated in the "receiver" of the apparatus or in an attachment thereto.

Take two round-bottomed glass flasks, the one having a capacity four to eight times greater than the other. Adjust the smaller upon a water-bath, the larger, at 10 or 15 inches distance from the other, over a sink or large basin, and connect the two with glass tubing and perforated caoutchouc stoppers, so that the connecting-tube shall incline slightly downward from its bend close to the stopper of the small flask. The stopper of the small flask is also to have a second perforation, in which is fitted a straight glass tube, 2 or 3 inches long, its lower end placed even with the lower end of the stopper. The upper end of this tube is very slightly drawn out for ¼ of an inch, and snugly fitted with 1½ inches of firm rubber tubing, the upper ½ inch of which is closed with a piece of glass-rod of same diameter as the body of the tube.

Now put an ounce or two of water in the large flask, and the material to be evaporated in the small flask; close the stoppers perfectly, by turning the flasks under them, and leave open the straight tube. Apply, by the water-bath, the limited degree of heat until it is imparted to the contents of the small flask; then move a lamp under the large flask until the water in it has boiled briskly and the steam therefrom has escaped continuously from the straight tube for some minutes. Now close tightly the straight tube with its caoutchouc cap, at the same time removing the lamp from the large flask. When the latter has cooled somewhat, wrap it smoothly with linen netting or gauze, and lead upon it a minute stream of cold water, controlling the same as required. The liquid in the small flask boils briskly (if aqueous, boiling at 120° to 150° F.), and the refrigeration is governed to prevent too violent ebullition, lest liquid be thrown into the connecting-tube; the degree of applied heat is governed to the same end.

An ordinary glass retort may be substituted for the small flask as an evaporating vessel, and its tubule may be fitted with a perforated stopper, admitting a thermometer. If there is not room in the stopper (of retort or flask) for both the thermometer and the steam-escape tube, the latter may be dispensed with by adjusting the stopper loose for escape of steam, and pressing it tight when the air is expelled. Flat-bottomed flasks favour equable boiling, but they are liable to collapse.

As a *condenser*, I have used, instead of the large flask, a copper vessel, for more ready application of heat without danger of breaking, and for more efficient refrigeration. This copper receiver (Fig.) is made of conical shape, with rounded bottom, a vertical diameter twice its horizontal diameter, and a neck bent to the angle of about 56° with the vertical axis of the vessel. The diameter of the neck is ¾ of an inch, to receive a retort beak, the joint being covered with a section of caoutchouc tubing. Or it may be fitted with a perforated stopper, to receive the connecting-tube of the flask when evaporation is conducted in the latter.

With linen netting to spread the water over the free surface of the condensers, the evaporation therefrom refrigerates with a comparatively small supply of water. Using a copper condenser of the above-described shape, a vertical diameter of 12 inches, and capacity of 6 pints, attached to an 8-ounce glass retort containing distillation promoters, I have vapourised 4 fluid ounces of water in sixteen minutes at the constant temperature of 128° F. By ordinary care in the expulsion of air and closure of the apparatus, exhaustion can be invariably secured, fixing the water boiling-point at or below 130° F.; that is, atmospheric pressure equal to at least 25 inches of mercury may be removed and sustained by availing ourselves of the displacing effect of steam, and the contraction of condensing vapour, in very simple apparatus.

Notwithstanding the illustrations of vacuum by condensation which abound upon the physical lecture-table, I do not know whether the devices suggested in this note have been tried or proposed for small chemical operations by anyone else. I have recommended them to students, and we have found them satisfactory for various analytical, experimental, and pharmaceutical operations. We have employed them chiefly in such evaporations as are performed for the residue only, or, at least, not for quantitative recovery of the distillate, in various evaporations of quantitative analysis, in the elimination of non-volatile alkalcids, in determining the organic matter in water, and in preparing fluid extracts. To evaporate at ordinary temperatures by hand-pump exhaustion is especially irksome in those cases when application of 125° to 150° F. is unobjectionable. And to connect a vessel under which heat may be applied with the air-pump involves quite as much labour as the arrangement of apparatus for exhaustion by condensation.

ON THE

ACTION OF CHLORIDE OF ZINC UPON CAMPHOR.

BY M. ADOLPH ROMMIER.

According to Gerhardt, when camphor is distilled over chloride of zinc, it changes into cymol and water, according to the following equation:—

$$C_{20}H_{16}O_2 = C_{20}H_{14} + 2HO.$$

MM. Lippmann and Longuinine,* Fittig, Koebrich, and Silke,† found great difficulty in preparing cymol from camphor, and observed during the reaction the formation of hydrocarbides homologous with benzol, which was also proved by ourselves upon repeating the experiment. Our experiments were made upon 2 kilos. of camphor, which when distilled four times over fused chloride of zinc, yielded about 700 kilos. of essence, which boiled at from 140° to 240°, and of which scarcely a tenth approached the boiling point of cymol. It was also ascertained that this essence, mixed with a solution of caustic potash, yields a product analogous to phenol. After precipitation by chlorhydric acid, 40 grammes were obtained, which, on distillation in a current of carbonic acid, yielded a small quantity of liquid, boiling below 200°, and the rest at a temperature somewhat higher. Here is the elementary analysis of this latter product:—

* *Bulletin de la Société Chimique*, Nouvelle série, tome vii., p. 374, 1867.

† *Ibid.*, tome x., p. 78, 1869.

	Experiment.	Calculation.
Carbon	76·87	77·77 (C_{13})
Hydrogen	8·13	7·40 (H_8)
Oxygen	15·00	14·83 (O_2)
	100·00	100·00

figures which correspond to cresylic alcohol.

The first was too hydrated for analysis; it was merely heated with oxalic and sulphuric acids, and the formation of rosalic acid proved characteristic of phenic alcohol.

These phenols have a slight but decided smell of phenic alcohol, whilst cresylic alcohol, obtained from tar, has a very disagreeable odour, being less easily purified than that obtained from camphor. Finally, in the reaction of chloride of zinc upon camphor, the formation of the sundry hydrocarbides and phenols shows that, contrary to what was believed, decomposition with deflagration ensued rather than simple dehydration, since if the experiment was carried on at a low temperature, the camphor distilled without alteration, whilst if the temperature was raised to the fusing point of the chloride of zinc, a still greater quantity of camphor remained unaltered even after four distillations.

ON ARTIFICIALLY-COLOURED WINES.

BY DR. T. L. PHIPSON, F.C.S.

When wine of any vintage is found to be wanting in colour, it is customary to mix it with a certain proportion of strongly-coloured wine grown in the South; for instance, with good Roussillon, &c. At Fismes and Poitiers, and probably in other parts of France, there exist, however, regular establishments where colouring matter for wines is manufactured on a somewhat extensive scale. And in Greece the flowers of the purple Holyoaks (*Althœa rosea*, *Malva arborea*, *Rose tremiere*) are collected for the like purpose to a considerable extent.

The material manufactured at Fismes is obtained from elderberry, both from the fruit of *Sambucus niger* and *S. ebulus*. The process is very simple. 250 to 500 parts of this richly-coloured fruit, with 30 to 65 parts of alum, and 600 to 800 of water, are the proportions generally employed. It has been stated that beet-root juice, blackberries, Brazil-wood, logwood, &c., are occasionally used, but, I believe, by no means so frequently as the substances above named.

Many methods have been tried in order to detect the presence of artificial colouring-matters in wines, but, it appears, with a very small amount of success. Œnocyanine may be precipitated from the wine, and its properties, studied with care, will show at once the presence of an adulterating material; but the process is rather long and delicate. I have shown, in a note on the "Absorption Spectra Yielded by Certain Organic Substances," * that the pure colouring-matter of the grape gives no absorption bands, but only a general absorption, increasing gradually towards the violet; whilst the colouring-matter of the purple Holyoak, dissolved in water containing a little alum, gives a distinct and wide absorption band in the neighbourhood of D. This allows its presence in wine to be detected without much difficulty; and the same method applies equally well to the colouring-matters of logwood and Brazil-wood.

I have not yet ascertained how the colouring-matter of elderberry fruit affects the spectrum, but it is not difficult to discover in wine, according to M. Fauré, by means of gelatine. The fact is that œnocyanine is easily precipitated along with the tannin when gelatine is added to red wine, whilst other colouring-matters (and, among them, that of the elderberry) are left in solution. If there happen to be not enough tannin naturally present in the liquid to precipitate all the œnocyanine, a little more must be added.

Alum will be often found in wine which is artificially coloured; it vivifies the tint, and is supposed to preserve the wine. Its presence is not only highly injurious to the health, but will effectually prevent the ripening of wine and the development of the bouquet.

The test to which I have called attention may be made as follows:—Take a specimen of the wine to be examined, and, if its color is too powerful when examined in a thin tube by means of the prism, it must be diluted with distilled water until a proper degree of transparency is obtained. A minute quantity of alum is then added, and the specimen examined in the spectroscope. If an absorption band of any kind shows itself, the wine may be suspected.

Analytical Laboratory, Putney, S.W., Nov. 1st, 1869.

* *Journal of the Chemical Society*, Sept., 1869, p. 324.

THE CHEMISTRY OF THE BLAST FURNACE.*

BY I. LOWTHIAN BELL.

My attention has just been directed to a translation of an article in your journal by Mr. C. Schinz, of Strasburg, entitled "The Chemistry of the Blast Furnace according to Mr. I. L. Bell's Experiments." In a subject, the investigation of which is attended with so many practical difficulties as this, we can scarcely hope to discover the exact truth at once, and I think I can now amend—indeed, I may say, I have in a recent paper amended—to a small extent, the views communicated to my colleagues in the Chemical Society of London, in the paper of which the article in question is a criticism. I shall at all times be glad to have my opinions freely canvassed; but in the present instance Mr. Schinz has overlooked those minor parts of the inquiry in which I have probably erred, and attacks me in language a little more forcible than is perhaps strictly necessary upon matters where I hope to show the fallacy is all on his side.

In my discourse to the Chemical Society, I expressed a dissent from the view which maps out a furnace into zones of strongly defined dimensions, and gave my reasons, one of which was the irregularity of the size of the pieces introduced into its interior. Mr. Schinz says this mode of charging a blast furnace is a mistake often committed in England. I said nothing to the contrary; I am dealing with the effect, not with the cause, and leave the practical smelter to discover whether the saving in fuel by a different mode of procedure will pay for the expense incurred in its adoption. I have stated elsewhere† that where such an expensive fuel as charcoal is employed, more care *is* taken in this item than with us, but observation in almost every iron-producing

* Communicated by the Author simultaneously to the Chemical News and *Engineering*.

† Paper on our foreign competitors in the iron trade.

country in Europe enables me to challenge Mr. Schinz to name one instance where the approach to uniformity of dimensions in the materials is usually such as he would have us suppose.

The measurement of temperatures of the escaping gases of blast furnaces is assumed as being founded "upon a delusion;" because, as this gentleman observes, pieces of metals such as I employed laid on the bottom of the gas pipe, will, from their superior conducting power, not be melted by reason of their contact with the cool pipe, while ore exposed to the current of hot gases, will, from its less conducting power, acquire a temperature superior to that indicated by the non-fusion of the test metals. Now there is not one word in my paper to justify any such inference as to the mode followed in estimating the temperature of the gases; for it happens the specimens of ore operated upon in the experiments quoted were suspended by a thin rod on a tray 2 or 3 feet from the side of the gas pipe, and the metals intended to denote the temperatures were placed on the same tray (6 inches square), so that all must necessarily have been equally heated. Besides, Mr. Schinz might have given me credit for more care in obtaining my data, seeing I mention the use of three different kinds of pyrometer, not one of which could, without great difficulty, have been applied in the blundering way he suggests.

But, continues this chemist, if my observations as to temperature are true, "my conclusion" is still only delusively correct, "because reduction is accelerated by proportionate quantity of gas, by the amount of carbonic oxide such gas contains, and by its temperature." Before Mr. Schinz undertook to correct me, I had published an account of experiments* undertaken to show how these three conditions affect the rapidity and extent of reduction, but neither of these phenomena is in question in the present discussion. Former experimenters had given the results of their observations as to the temperature at which reduction *begins* in a blast furnace, and I gave the grounds for respectfully dissenting from opinions entertained by such eminent men as Tunner, Ebelmen, and Scheerer.

Mr. Schinz then proceeds to pass an opinion upon Tunner's analysis of the gases of the Wrbna furnace, which he says is "decidedly wrong," and then observes that the composition given of the gas of one of the Clarence furnaces is "just as false."

I may fairly leave the reputation of my friend, Professor Tunner, as a correct observer, to stand upon its own merits, and reserve my observations for pointing out to Mr. Schinz what is really involved in his somewhat gratuitous observation respecting the analysis of the Clarence gases. I quote the results obtained as they are given in my paper:—

Volumes in 100 Volumes.	CO_2		CO		N by Difference.	
Hour of taking Sample. p.m.	1st Trial.	2nd Trial.	1st Trial.	2nd Trial.	1st Trial.	2nd Trial.
1.0	6·25	—	26·30	—	67·45	—
1.55	6·24	6·70	34·70	—	59·06	—
2.15	6·94	6·73	34·40	35·40	58·66	57·87
3.0	5·30	5·75	35·80	35·64	58·90	58·61
3.15	4·75	5·12	31·00	30·25	64·25	64·63
3.55	5·91	—	31·12	—	62·97	—
4.20	5·82	6·00	29·72	28·90	64·46	65·10
Average being	5·88	—	31·86	—	62·26	—

* Paper read at Middlesbrough meeting of Iron and Steel Institute, September, 1869.

Now, if the above figures had been obtained by an incompetent operator, one would have expected to have found discordant results upon the repetition of the analyses, and there being no evidence whatever of this, the word "false," used by Mr. Schinz, has, to my mind, a somewhat unpleasant sound.

To its application, however, I must submit, if this gentleman is correct in his assertion that furnace gas, having a composition like that given, is "almost impossible;" for he proceeds to show how, taking the nitrogen as the basis of his calculation, the quantity of oxygen, and hence of carbon, are incompatible with the ratio in which the first two elements exist in the atmosphere, having, of course, regard to the oxygen in the ore. In the estimate which has to prove how false my data are, Mr. Schinz assumes that the sole sources of oxygen are the blast and the ore, for he never gives a thought to the *limestone*. Now this is the less excusable, seeing that in the very next page in my paper, the theoretical composition of furnace gases is compared with that furnished by analysis, and the sources of each of the constituent parts are given, among which the limestone is distinctly mentioned. I shall not trouble you with all Mr. Schinz's figures, but content myself with giving a statement, by which it will be seen how nearly the analysis agrees with what the furnace was using at the time the gases were collected for the examination, assumed by this gentleman to be so incorrect.

The consumption for each ton of iron at the time was:—

	cwts.
Coke	29·50
Limestone, calcined, and containing about 22 per cent of carbonic acid	15·50
Ironstone	49·50
The coke contained of carbon	27·14
" " ash, moisture, &c	2·36
	29·50

The carbon which would be volatilised was:—

That contained in the coke	27·14
" " limestone partially calcined	0·93
	28·07
Less that to combine with the iron	0·74
	27·33

The gases of which the volumetric analysis is objected to by Mr. Schinz had the following composition:—

By volume.		By weight.		
CO_2	5·88	8·94	Carbon	15·65
CO	31·86	30·82	Oxygen	24·11
N	62·26	60·24	Nitrogen	60·24
	100·00	100·00		100·00

From these proportions, the gases for each ton of iron will consist, by weight, of—

	Cwts.		Carbon.	Oxygen.
Nitrogen	105·20		—	—
Carbonic oxide	53·83	=	23·07	30·76
Carbonic acid	15·61	=	4·26	11·35
	174·64		27·33	42·11

Thus, then, 42·11 cwts. of oxygen are associated with the 27·33 of carbon set out with as having been volatilised. For this we have oxygen accompanying the nitrogen found

[English Edition, Vol. XX., No. 520, pages 233, 234.]

	cwts.
in the gases, which would be—105·20 × 2/3	31·42
The iron in 20 cwts. of pig is 19 cwts., which, as peroxide, is equal to oxygen	8·14
Oxygen combined with 0·93 carbon in the carbonic acid of limestone	2·48
	42·04

instead of 42·11, which will probably be accepted as a nearer approximation to truth than the words "almost impossible" would seem to convey.

The actual numbers objected to by Mr. Schinz were CO_2 6, Co 32, N 62, which was merely the volumetric composition of a mixture made for the purpose of comparing its effect in deoxidising iron ore with that of a second mixture, made to resemble the gases of the Wrbna furnace. These numbers, it will be perceived, closely resemble the analysis just examined.

This omission of limestone, as contributing to the constituents of the furnace gases, is repeated by Mr. Schinz when he examines my comparison of the gases produced by the use of hot and cold air in Wales, neither of which, it is expressly stated, were analysed, but assumed as resembling those of the Clarence Works for the sole purpose of estimating the quantity of heat carried off by their means.

In these instances, the gases were considered as consisting, by weight, of CO_2 9, CO 32, N 59; numbers which differ but slightly from those deduced from the analysis of the Clarence gases, as formerly stated.

I find I have made two errors in the calculation based on this assumption. The weight of gases from the cold blast

	CO_2.	CO.	N.	HO.	Total.
furnace should be....	18·20	64·70	119·40	3·93	206·23
instead of, as formerly	18·19	64·73	124·60	3·93	211·45
and from the hot blast					
it should be.....	13·50	48·10	88·60	3·06	153·26
instead of, as before..	12·94	46·22	92·73	3·06	154·95

The difference, however, between these two sets of figures is so small as not materially to affect the conclusions drawn from them; but Mr. Schinz arrives at a very contrary opinion by changing the weight of nitrogen, given above in the case of the cold blast furnace, from 124·6 to 142·6, and, not satisfied with this mistake, commits another in the arithmetic used in working out the result from the hot blast furnace, by which he makes the ratio of the volumes of carbon vapour and oxygen per 100 volumes of nitrogen to be 35·82 of carbon and 41·22 of oxygen instead of 29·4 and 33·8 respectively.

In alluding to my remarks on the hot blast, Mr. Schinz (*àpropos* of nothing I said) mentions that, "with cold blast an increase of fuel will always yield a product richer in carbon graphite, whilst an increase of temperature by means of the hot blast will never secure the same success." All I can say is the experience of twenty-five years with blast furnaces and that gained by a constant study of a present annual make of 120,000 tons of iron has produced no such impression on my mind. Neither am I disposed to accept as a "solution of the problem relating to the wonderful effect of the hot blast," Mr. Schinz's explanation, who considers solid carbon and not carbonic oxide as the reducing agent.

If my experiments are "worthless," the calculations of Mr. Schinz are not of a very accurate order, for he founds an estimate of heat units supplied to a furnace on the assumption that 113 kilos. of carbon require 3881 kilos. of air for conversion into carbonic oxide, whereas it ought to be 655 kilos., and equally so is his calculation which proves hot blast iron to require more fuel than that smelted with cold air.

I am censured, too, for not being able to distinguish between height and capacity in referring to the economy in fuel effected by a change in the dimensions of blast furnaces. My language may be defective in clearness, but it seemed to me that when I stated that the Lilleshall furnaces saved coal by an addition of 21 ft. to their height, none but a very fastidious critic could have imagined this alteration in form to have been made without their capacity having been increased to a corresponding extent.

There is little in Mr. Schinz's review of my work I am disposed to assent to, but I am unwilling to trespass further on your space, which I have been induced to do at some length in order that the Fellows of the Chemical Society, who honoured me by an invitation to give an address on applied chemistry, should not think I had complied with their request in the negligent manner this gentleman would have them believe.

Washington, Durham.

FLUX FOR BLOWPIPE ANALYSIS.

BY PROFESSOR HOW, D.C.L., WINDSOR, NOVA SCOTIA.

Under the heading given above, the Chemical News last year (vol. xviii., p. 203; *Amer. Repr., Dec.*, 1868, *page* 323) reprinted a note by Mr. S. D. Poole to the *Scientific American* on the advantages of a mixture of selenite and fluor over the well-known flux of bisulphate of potassium and fluor devised by Turner as a reagent for producing coloured flames before the blowpipe, and over selenite alone as an addition to silicates, recommended by Fresenius. Mr. Poole's objection to the former is the intense violet tint given to the flame by potassium, and to the latter, its infusibility and want of decomposing power. This reagent, he says, "forms an easily fusible bead, which by itself gives only a very faint dull red tint (lime) to the flame, but which renders the presence of such elements as give colour most beautifully evident and characteristic."

My present object is to point out that the newly proposed flux is of more limited applicability than that of Turner, because there is no provision in it for the liberation of hydrofluoric acid. In testing for boracic acid *e.g.*, it fails completely to give the green flame with natroboro-calcite and with borax, whereas Turner's flux gives a distinct reaction in each case. When silica is present in minerals along with much boracic acid, the addition of either of these fluxes is superfluous; thus with silicoboro-calcite a fine green—not yellowish green—is obtained with the mineral alone. Sussexite gives a yellowish green colour alone, and the addition of Poole's flux seems to me to obscure the reaction, while Turner's gives a fine green flame. As regards some other colouring elements, when colour is given by minerals alone, the best colour is obtained without the new flux; this is the case with celestine and strontianite. When silica is present, the test answers well in some instances, as with lepidolite and spodumene, and especially, as Mr. Poole states, with the felspars in which K and Na exist alone or predominate respectively. I may mention that small quantities of boracic acid which escape detection by using even Turner's flux, may be discovered in minerals soluble in HCl by repeated wetting and drying of the turmeric paper.

SUPERSATURATION, SURFUSION, AND SOLUTION.

BY M. DUBRUNFAUT.

Supersaturation is evidently a badly-defined phenomenon of solution; and a study of these phenomena is the only way of ascertaining the cause of supersaturation.

The interesting labours of M. Gernez, animated by the beautiful experiments of M. Pasteur, have established, in the most complete manner, the active part invariably played by the crystal which causes a cessation of the state of supersaturation in similar or isomorphous crystals. This proves the existence of a special power in the crystals themselves, varying in its mode of being according to their chemical and geometrical formation. But the labours of M. Gernez end here; they show, in fact, in the case of sulphate of soda, for instance, the generalisation of the long-known property possessed by a crystal of sulphate of soda of causing a supersaturated solution of the same salt to instantly assume the form of a crystalline mass. Nothing, however, of the cause of this fact, or of its relation with the condition of supersaturation, has been explained.

M. Loewel has fully proved, with regard to the supersaturation of sulphate of soda,* that the salt dissolved as the compound $SO_3NaO.10HO$ is found in solution in the state of $SO_3NaO.7HO$. The experimental demonstration of this fact appears to be the result of the exact analysis of crystals formed simply by lowering the temperature of the supersaturated liquid. The dissolved salt which is thus brought into a state of supersaturation changes its nature, or, at least, its molecular constitution. It now becomes a totally different product, possessing other properties, and that which is considered as supersaturation of the primitive product is really, in the new substance derived from it, merely a normal saturation; in other words, sulphate of soda is dissolved in water in the proportion of 10 equivalents of the latter, and, upon overcharging the solution with an excess of the salt, its composition is modified in such a manner as to create a new and more soluble product, consequently susceptible of producing that apparently strange phenomenon called supersaturation.

This interpretation of the facts relating to supersaturation does not detract the rules of the experimental method; and, by developing its logical consequences, the theory may be generalised and applied to all cases of solution, even to those not possessing the characteristic properties of supersaturation.

If it be certain (as we admit) that the sulphate of soda, with 10 equivalents of water, exists in the so-called supersaturated solution, with the molecular composition characterised by 7 equivalents HO, it is none the less true that, under certain known conditions, the composition of the salt may return to its primitive condition, which clearly proves, in the dissolved sulphate of soda, an unstable and fugitive molecular condition, which any accident or untoward circumstance may alter or destroy. This is what happens, in fact, under the influence of a crystal similar to sulphate of soda with 10 equivalents of water, or of an isomorphous salt; and, in this case, the return of the salt to its primitive composition is accompanied by a thermic manifestation, which confirms the change, such as may be noticed in amorphous allotropic changes, and in those of substances which crystallise in two shapes.

The modifications which matter presents in solution are confirmed, under another form, by the fact of double molecular rotation, which has been observed in crystallisable glucose, lactine, and their derivatives. In these cases, the crystallisable substances evidently contract the molecular constitution which they display at the moment of solution from the power of crystallisation, and it lasts sufficiently long to be quite perceptible. In the case of crystallised glucose, the transition of birotatory to the state of mono-rotatory glucose requires, at a low temperature, four or five hours for completion.

This property is not perceptible in all molecularly-active substances, but it is believed to be general and proper, not only to all substances possessing the molecular property, but to all soluble substances whatsoever.

It is, therefore, highly probable that all soluble, crystallisable, or amorphous bodies have, when in solution, a different molecular constitution to that possessed by them when in a solid condition. This modification, as is proved by supersaturation and double rotation of glucose, is only ephemeral, and depends upon the particular condition of the substance in solution, and perhaps, also, on the nature of the solvents; it ceases when the causes which produce it are removed.

Thus it is retained by crystallised glucose in its crystalline state, whether its constitution be $C_{12}H_{12}O_{12}$ or $C_{12}H_{14}O_{14}$; but the moment that the crystal becomes liquefied, either by melting or by any kind of solvent, its molecular constitution, displayed by its rotatory power, is changed, and can only be regained by a return to the solid condition. Thus all known facts relating to supersaturation and surfusion may be explained without the necessity of distinguishing these different conditions of matter by the physical causes which annul them.

Solution, regarded thus, enters into the category of known chemical forces, which modify, in a regular and invariable manner, the arrangement of elements in integrant molecules.

After a careful examination of osmotic analysis as applied to complex saline solutions, I find that it is impossible to agree that diffusibility, which is, as we have demonstrated, the vehicle of this mode of analysis, occurs when the substance in question is in a solid state; on the contrary, everything goes to prove that the elements of the current of exosmose which produce the analysis are derived from a fraction of the solvent charged with the diffusible product. If this were not so, it would be difficult to account for what passes in my methodical analysis of molasses, in which the diffusion of sugar is constant at every period of the analysis, whilst the diffusion decreases geometrically in proportion as the analysis reaches its termination.

It certainly must be admitted that, in a solution of sundry salts, possessing different physical and chemical properties, each salt takes and retains, even in the complex solution itself, that contingent of the solvent assigned to it by its special qualities. It is upon these molecular liquid groups, which are more or less defined in every medium, that the force of diffusion is exercised which acts in so evident a manner in all cases of endosmotic analysis.

Here is another important fact in molecular physics which has been confounded by experimentalists with those of supersaturation.

When a crystallisable substance, such as sugar, is

* M. Gernez, who has studied this subject with care, attributes the priority of the observations in question to foreign observers; but M. Loewel has also worked them out in a much better manner, without having previously heard of them, and therefore deserves the credit of an original discovery.

extracted from its solution in water by very strong alcohol, two different cases may arise, according to the conditions of the experiment, in which the sugar remains for a moment in a state resembling the phenomenon known as supersaturation, but which really differs from it essentially, or the sugar is precipitated in viscous lumps resembling precipitates formed under the same conditions by gum, dextrine, &c.

Upon examining this precipitate with a microscope, an amorphous or globular texture is easily observed, and these products float in the alcoholic solution. After a certain time, the viscous precipitate is transformed into well-defined prismatic crystals of sugar. These facts appear frequently, if not always, under the experimental conditions specified by M. Margueritte—to separate sugar from molasses by means of alcohol and sulphuric acid. This effect has been confounded with the known phenomenon of supersaturation. Under these conditions, alcoholic solutions said to be exclusively supersaturated furnish their contingent of sugar without change of density, which proves that all the sugar obtained was the result of amorphous sugar. Is not this transitory state of the sugar shown by the action of the alcohol on the dissolved sugar, the normal condition of sugar modified by solution? and is not this experiment a fresh proof in support of my mode of considering the phenomena of solution and supersaturation?

Is not that particular state of matter to which Mr. Graham has given the name of *the colloid condition*, a transitory and ephemeral condition analogous to that to which I have just called attention with regard to crystallisable sugar, and which is common to a number of other substances soluble and crystallisable from alcohol? —*Comptes Rendus.*

MODIFICATION OF THE METHODS FOR THE

VOLUMETRICAL ESTIMATION

OF THE

QUANTITY OF COPPER AND ZINC CONTAINED IN ORES,

BY MEANS OF A STANDARD SOLUTION OF FERROCYANIDE OF POTASSIUM.

BY M. MAURIZIO GALETTI,

CHIEF ASSAYER AND CHEMIST OF THE ROYAL ASSAY OFFICE AT GENOA.

When the ores of copper or zinc, after having been acted upon by acids, are treated with excess of ammonia in order to precipitate the oxide of iron, that substance invariably retains larger or smaller quantities of the oxides of the metals just named. The quantity thereof so retained varies according to the larger or smaller quantity of copper and zinc contained in the ores. It is hence necessary to repeat the treatment with ammonia at least twice, sometimes even three and four times, in order to obtain a complete separation of copper or zinc from the iron.

In order to obviate the loss of time which is caused by these operations, the author proposes to convert into acetates the small quantities of the oxides of copper and zinc which accompany the precipitate of oxide of iron. This can be effected by two different methods, dependent on the fact whether the oxide of iron is removed by filtration (previous to the use of standard solution of ferrocyanide of potassium), or is left in the ammoniacal liquid. The operation is conducted as follows:—

Suppose a copper pyrites to be submitted to analysis. Take 1 grm. of the previously very carefully pulverised and dried ore. Treat it first with concentrated nitric acid, boiling to incipient dryness, in order thereby to free the sulphur from any small particles of ore which are at first taken up by it. Add 10 c.c. of hydrochloric acid, boil down to about half that bulk, dilute with distilled water, and next add ammonia in large excess; boil the fluid, and next add pure acetic acid (sp. gr. 1·070) until the liquid assumes an emerald-green colour. After the liquid has been well stirred up, boil again for about two minutes; then add again ammonia in excess. The liquid is then poured out of the flask into a suitable glass vessel, and the flask is rinsed out with a sufficient quantity of distilled water to bring the bulk of the fluid up to ½ litre. This having been done, the fluid is very cautiously and gradually acidified with very dilute acetic acid, 1 part of the acid just alluded to, and 10 parts of distilled water. Any large excess of this acid should be avoided; the fluid should only be very slightly acid. As soon as the basic acetate of iron has subsided, the precipitation of the copper by means of the standard solution of ferrocyanide of potassium is proceeded with.

Since the oxide of copper which might have adhered to the oxide of iron has been converted by the process just described into a soluble salt, it cannot fail to be completely precipitated by the ferrocyanide of potassium solution. When a determination of copper has to be made in ores which are rather poor (that is to say, contain less than, or up to, 6 per cent of copper), it is preferable to add to the nitric acid solution 0·1 grm. of pure copper, which quantity has to be deducted afterwards from the results obtained. This precaution is required in order to prevent the presence of a large quantity of oxide of iron from vitiating the results of analysis of poor ores. When ores contain up to 12 per cent of copper, a quantity of 1 grm. of the ore should be taken; but, for richer ores, 0·5 grm. is sufficient. It is always advisable to make a control analysis with pure copper at the same time while testing the ores.

The second modification is carried out in the following manner.

After the second addition of ammonia to the liquid, it is filtered, and the precipitate is washed with a dilute and boiling solution of acid acetate of ammonia. This solution is prepared by saturating 20 grms. of pure acetic acid with ammonia, and addition thereto of 15 grms. of pure acetic acid in 585 grms. of water. When the washing of the oxide of iron is carefully done, the salt of copper, which tenaciously adheres to the oxide of iron, is entirely removed therefrom; but it will require about 400 grms. of the fluid, the preparation of which has just been described.

The normal solution of copper should be treated as follows.

A quantity of 0·2 grm. of pure copper is dissolved in nitric acid; excess of ammonia is added; the fluid next acidified with acetic acid, thereupon diluted with 400 grms. of acid acetate of ammonia, and the whole brought up to 500 grms. To this solution 20 c.c. of the standard solution of ferrocyanide of potassium are added, and, after the necessary corrections have been made, the liquid must not contain any more excess of either copper or of ferrocyanide.

The standard solution of ferrocyanide of potassium

to be used for the determination of copper is made by dissolving 50·225 grms. of ferrocyanide in as much distilled water as will suffice to make the solution weigh exactly 1 kilogramme.

The ferrocyanide solution destined for the estimation of zinc is made by dissolving 41·250 grms. of the said salt in the same quantity of water.

If it should happen that the copper ores contain zinc, nickel, and cobalt, the copper should be first separated from these metals, either by precipitating the copper from its solution in acid by means of zinc, or as sulphide of copper by means of hyposulphite of soda.

Zinc ores are treated in the very same manner as just described for copper ores. When sulphuret of zinc (the "black-jack" of English miners) is to be operated upon, care should be taken that, after the addition of hydrochloric acid, the fluid should be sufficiently far evaporated as to insure the expulsion of all nitric acid. Since zinc ores are usually rather rich, ½ grm. is sufficient for analysis. Calamine-stone (native carbonate of zinc) should at once be acted upon with hydrochloric acid; but, in order to make sure of the complete oxidation of all the iron the ore may happen to contain, it is best to add to the acid a few decigrammes of pure chlorate of potassa. After having suffered this solution to boil for a few minutes, it is diluted with distilled water; a large excess of ammonia is added to the solution, and it is next treated as above-described for copper.

The author states that he has convinced himself, by a set of experiments instituted on purpose, that the presence of compounds of lead (as, for instance, carbonate, sulphate, and sulphide of lead) occurring along with the ores of zinc, does not interfere with the correctness of the complete precipitation of zinc as ferrocyanide of zinc. This even holds good up to 10 per cent of metallic lead, a quantity which does not, also, interfere when mixed with copper ores.

Since some ores of zinc, especially calamine-stone, may, and often do, contain manganese, it is best to add to the ammoniacal solution, before any acetic acid is added, a few drops (from 2 to 4) of bromine, in order to convert thereby the protoxide of manganese into proto-sesquioxide, leaving the solution standing for twenty-four hours after the addition of the bromine.

Since the ammoniacal solution of chloride of zinc is colourless, there should be added to it, previous to the very cautious acidification by means of dilute acetic acid, a few drops of tincture of litmus, in order to more readily hit the precise point of sufficient acidification, to be exhibited by the blue colouration changing to a rose-red.

When iron is present, the same precautions are to be observed as described under copper.

The ferrocyanide of zinc which is mixed with oxide of iron preserves its naturally white colour as long as the liquid yet contains free zinc, but its colour changes to a greyish white as soon as a very slight excess of the ferrocyanide standard solution is present; the liquid then also becomes turbid, and the precipitate settles very slowly. By these constantly occurring and quiet characteristic signs, the end of the operation may be always recognised. In order to make sure, the liquid should be stirred up with a glass rod which has been just previously moistened with an acidified and dilute solution of ammoniacal nitrate of copper, which will have the effect of indicating any excess of the ferrocyanide solution, by exhibiting the more or less intense colour characteristic of ferrocyanide of copper. The zinc solution should be at a temperature of from 40° to 50°, whereby the rapid precipitation and subsidence of the ferrocyanide of zinc is promoted.

When filtration is avoided, the presence of the gelatinous silica (due to the decomposition of silicates of zinc occurring in the ores of that metal, and brought to a gelatinous condition by the treatment of such ores with hydrochloric acid) does not interfere with the correctness and good results of this method of estimating zinc quantitatively in its ores.

It is gratifying to learn that, since the discovery of extensive and very valuable zinc ore deposits (calamine-stone) in the island of Sardinia, and the demand for this ore created in England, France, Belgium, and Rhenish Prussia, a committee of analytical chemists from these countries have, after having previously made themselves fully acquainted with the method of analysis of zinc ores just described, unanimously resolved to estimate the zinc (to be brought under contract to each of the countries just named from Sardinia) by the method here described, as being the best suited for the purpose.—*Zeitschrift für Analytische Chemie.*

ON A NEW CHROMIUM OXYCHLORIDE.*

BY T. E. THORPE, PH.D.,

ASSISTANT IN THE LABORATORY OF OWEN'S COLLEGE.

When chromyl dichloride $CrO_2\left\{\begin{matrix}Cl.\\Cl.\end{matrix}\right.$ prepared by heating a mixture of potassium dichromate, sodium chloride, and sulphuric acid, is maintained at a temperature of 180° C.—190° C. in a sealed tube for three or four hours, it is almost completely converted into a black solid substance, and on opening the tube when cold a considerable quantity of free chlorine escapes. By exhausting the tubes containing the liquid chloride before subjecting them to heat, I have ascertained that chlorine is the only gaseous product of this decomposition. The black compound invariably contains more or less of the liquid chlorine which has escaped decomposition: the greater part of this is easily expelled on gently heating the mass after opening the tube. In order to free it completely from the latter body, the black substance was transferred to a clean tube and heated to 120° C. (*i.e.*, about 2° above the boiling point of chromyl dichloride) in a current of dry carbonic acid gas until its weight appeared constant. The following determination of the amount of chlorine contained in the volatile portion shows that it is simply chromyl dichloride which has remained undecomposed.

0·8741 grm. liquid chloride gave 1·6458 grms. silver chloride.

Calculated for CrO_2Cl_2.	Found.
45·7 per cent.	46·5 per cent.

The solid substance dried in the manner above described appears as a black unerystalline powder, which when exposed to the air rapidly deliquesces to a dark reddish brown syrupy liquid which smells of free chlorine. When thrown into water it quickly dissolves, forming a dark brown solution, which on standing also evolves chlorine. In nitric acid solution hypochlorous acid appears to be produced. In strong hydrochloric acid the substance dissolves with a dark brown colouration, and on boiling the solution, chlorine is evolved, the liquid

* Read before the Manchester Literary and Philosophical Society, November 2, 1869.

becomes greenish yellow, and ultimately changes to the dark green colour peculiar to a solution of chromium sesquioxide in hydrochloric acid. When thrown into dilute ammonia, chromic acid is dissolved, together with all the chlorine, and a precipitate is formed possessing the properties of the chromate of chrome sesquioxide ($Cr_2O_3CrO_3$) described by Storer and Eliot. Upon this decomposition is based the method which I have employed for the estimation of the amount of chloride contained in this body. The weighed quantity of the substance was treated with very dilute ammonia, the solution boiled for a few minutes, filtered, the precipitate well washed by hot water, an excess of nitric acid added to the filtrate, and the chlorine precipitated by the addition of silver nitrate. Two determinations of chlorine carried out in this manner on preparations made at different times gave the following results:—

Preparation I.

0·5900 grm. substance gave 0·4870 grm. silver chloride and 0·0069 grm. metallic silver.

Preparation II.

0·493 grm. substance gave 0·4250 grm. silver chloride.

Prep. I.	20·80 per cent Cl.
Prep. II.	21·32 " "
Mean.	21·06

In order to determine the amount of chromium it contains a weighed portion of the substance was repeatedly heated with strong hydrochloric acid on a water-bath until the evolution of chlorine entirely ceased; the solution was then diluted with water, heated to boiling, ammonia added in slight excess, and again boiled until the supernatant liquid appeared perfectly colourless. The precipitated chrome sesquioxide was then filtered, dried, and weighed.

Preparation I.

0·3442 grm. substance gave 0·2470 grm. chrome sesquioxide.

0·5900 grm. substance gave 0·4235 grm. chrome sesquioxide.

Preapration II.

0·5082 grm. substance gave 0 3590 grm. chrome sesquioxide.

0·5942 grm. substance gave 0·4210 grm. chrome sesquioxide.

Prep. I.	49·30	per cent Cr.
	49·25	" "
Prep. II.	48·45	" "
	48·62	" "
Mean.	48·91	

Hence the percentage composition of the substance is as follows:—

	Found.	Ratios.	Calculated.
Chlorine	21·06	2	21·86
Chromium	48·91	3	48·54
Oxygen	30·03	6	29·60
	100·00		100·00

I have attempted to control the above empirical formula ($Cr_3O_6Cl_2$) by heating a weighed portion of the substance in hydrogen. The action of hydrogen upon the new chloride when heated is extremely energetic. At a comparatively low temperature it takes fire, combustion proceeds rapidly throughout the mass, and ultimately the substance is converted into chrome sesquioxide, hydrochloric acid, and water. Care must be taken to regulate the current of the hydrogen, since, if too rapid, particles of the finely divided sesquioxide are apt to be mechanically carried away. From an experiment, in which the gas was carefully purified from oxygen by passing it through strongly alkaline pyrogallate solution and over heated metallic copper, and then dried by transmitting it through tubes containing pumice moistened with strong sulphuric acid, the following numbers were obtained:—

0·8715 grm. substance gave 0·6150 grm. chrome sesquioxide.

Found 70·58 per cent Cr_2O_3.

$Cr_3O_6Cl_2$ gives by calculation 70·72 per cent.

I had an additional object in thus studying the action of hydrogen upon the new chloride. I considered that this action might, possibly, throw some light on the constitution of this compound. The new oxychloride may, in conformity with the analytical results, be regarded as a compound of chromous chloride with two equivalents of chromium trioxide. Now, chromous chloride, according to Moberg, may be heated in hydrogen to the softening point of glass without suffering decomposition, and if it were found that water was the only volatile product of the reaction, we should possess a certain amount of evidence for supposing that the formula $CrCl_2,2CrO_3$ represents the constitution of this substance. Experiment showed, however, that the chlorine was not so firmly united in this compound as in the chromous chloride: on gently heating the substance in hydrogen, hydrochloric acid was immediately evolved.

Péligot has described a series of salts to which are assigned the general formulæ MCl, CrO_3 and $M''Cl_2,2CrO_3$, where M represents a monovalent metal and M'' a divalent metal. The following are the names and formulæ of the salts prepared by Péligot.

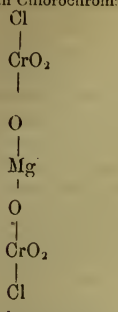
KCl,CrO_3	Potassium chlorochromate.
$NaCl,CrO_3$	Sodium chlorochromate.
NH_4Cl,CrO_3	Ammonium chlorochromate.
$MgCl_2,2CrO_3$	Magnesium chlorochromate.
$CaCl_2,2CrO_3$	Calcium chlorochromate.

Now the new oxychloride stands in a very evident relation to these compounds. Supposing, for a moment, that the formulæ given to these substances correctly represent their constitution, then the new oxychloride may be regarded as the chromium term of the series—divalent chromium replacing magnesium or calcium.

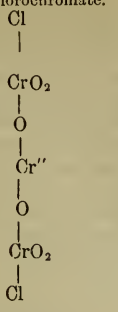
$$Cr''Cl_2,CrO_3,$$

a formula identical with that of which I have just attempted to show the impropriety. But there is still another reason for supposing that a compound thus constituted could not exist. Chromous chloride is one of the most energetic deoxidising agents known, and we can hardly conceive it to be united in a stable compound with a substance which so readily parts with its oxygen as chromium trioxide. Hence I am disposed to regard the constitution of the salts of Péligot as very different from that implied by the above method of representation: indeed, to the best of my knowledge, the general formula assigned to these salts expresses not a single experimental fact, unless it be the mode of their decomposition by water; probably it had reference to the views of Rose and Berzelius respecting the constitution of the so-called chlorochromic acid. The following structural formulæ better represents, in my opinion, the constitution of these compounds and their relation to chromyl dichloride.

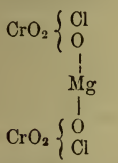
Magnesium Chlorochromate.

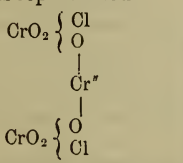


Chromium Chlorochromate.



These substances may also be thus represented—





The relation of the new oxychloride to chromyl dichloride is thus very apparent. Three molecules of chromyl dichloride when heated are resolved into one molecule of chromium chlorochromate and four atoms of chlorine.

THE LATE ECLIPSE, AND ITS OBSERVATIONS IN THE UNITED STATES.

As might be expected from the easy accessibility of the entire line of totality, this eclipse has been most thoroughly observed by numerous parties, the report of whose work will in due time be presented to the scientific world. Among the methods of observation, photography played an important part, and we have now before us an admirable series of views obtained by a large party organised and conducted by Dr. Henry Morton, Professor of Chemistry in the University of Pennsylvania, whose communications have sometimes appeared in our columns.

These pictures show, in the first place, very fine definition in the telescope employed, as the roughness or mountainous character of the moon's edge is clearly given in the pictures of partial phase, as well as the sun-spots and surrounding faculæ.

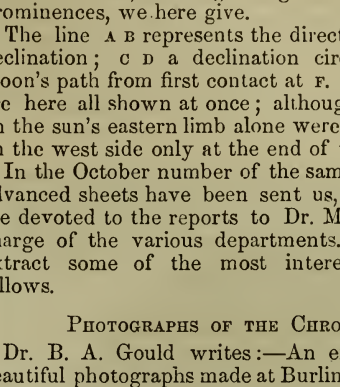
Thus, Professor A. M. Mayer, who took charge of one of the three sections of Professor Morton's party, has shown, by measurement on the photographs, a change of shape in one of the larger spots during the eclipse, amounting to a motion of 2000 miles in its edges.

During totality, no less than thirteen negatives were secured, showing a large number of prominences, some massive and others delicate, as well as radiant brushes of a softer light, such as have been before seen, but never as yet photographed. By another of the sections of this large party, besides similar pictures to the above, one was obtained showing the curious phenomena known as Bailey's beads.

The time of exposure determined by Professor Mayer for the partial-phase pictures was the 1-500th of a second. Those taken during totality were exposed from five to sixteen seconds.

The *Journal of the Franklin Institute* for September has sixteen pages devoted to Professor Morton's report of his expedition to Professor J. H. C. Coffin, U. S. N., Supt. of the *Nautical Almanack*, under whose authority this and other expeditions were organised, with an admirable photograph from one of the totality negatives, and several woodcuts.

One of these, showing the general character of the prominences, we here give.



The line A B represents the direction of a parallel of declination; C D a declination circle. F E is the moon's path from first contact at F. The prominences are here all shown at once; although, of course, those on the sun's eastern limb alone were seen at first, those on the west side only at the end of the totality.

In the October number of the same journal, of which advanced sheets have been sent us, thirty-eight pages are devoted to the reports to Dr. Morton of those in charge of the various departments. From these we extract some of the most interesting portions as follows.

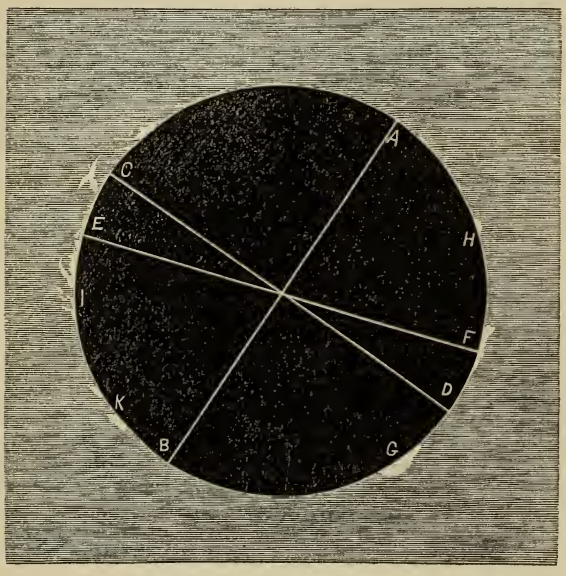
Photographs of the Chromosphere.

Dr. B. A. Gould writes:—An examination of the beautiful photographs made at Burlington and Ottumwa by the sections of your party in charge of Professors Mayer and Himes, and a comparison of them with my sketches of the corona, have led me to the conviction that the radiance around the moon in the pictures made during totality is not the corona at all, but is actually the image of what Lockyer has called the chromosphere.

This interesting fact is indicated by many different considerations. The directions of maximum radiance do not coincide with those of the great beams of the corona; they remained constant, while the latter were variable. There is a diameter approximately corresponding to the solar axis, near the extremities of which the radiance upon the photographs is a minimum, whereas the coronal beams in these directions were especially marked during a great part of the total obscuration. The coronal beams stood in no apparent relation to the protuberances, whereas the aureole, seen upon the photographs, is most marked in their immediate vicinity; indeed, the great protuberance, at 230° to 245°, seems to have formed a southern limit to the radiance on the western side, while a sharp northern limit is seen on all the photographs at about 350°, the intermediate are being thickly studded with protuberances which the moon displayed at the close of totality. The exquisite masses of flocculent light on the following limb are upon the two sides of that curious prominence at 93°, which at first resembled an ear of corn, as you have said, but which, in the later pictures, after it had been more occulted, and its southern branch thus rendered more conspicuous, was like a pair of antelope horns, to which some observers compare it. Whatever of this aureole is shown upon the photographs was occulted or displayed by the lunar motion, precisely as the protuberances were. The variations in the form of the corona, on the other hand, did not seem to be dependent in any degree upon the moon's motion.

The singular and elegant structural indications in the special aggregations of light on the eastern side may be of high value in guiding to a farther knowledge of the chromosphere. They are manifest in all the photographs by your parties which I have seen, but are especially marked in those of shortest exposure, such as the first one at Ottumwa. In some of the later views, they may be detected on the other side of the sun, though less distinct; but the very irregular and jagged outline of the chromosphere, as described by Janssen and Lockyer, is exhibited in perfection.

This happy result is clearly attributable to the relative shortness of the time of exposure, by which the highly photographic rays of the chromosphere have depicted themselves, without obliteration by the mass of coronal light which veiled them from the eye. Let us hope that, at the next total eclipse, some impressions may be taken with an exposure not exceeding a single second. The inference seems warrantable, that, in this way, better than in any other, the internal structure of the protuberances may be exhibited, though other phenomena may fail to record themselves.



You will observe that some of the brighter, petal-like, flocculi of light have produced apparent indentations in the moon's limb at their base, like those at the bases of the protuberances. These indentations are evidently due to specular reflection from the moon's surface, as I stated to the American Association at Salem, last month. Had any doubt existed in my mind, previously, it would have been removed by an inspection of the photographs.

Abstract of Professor Young's Report.

The observer was a member of the party under the direction of Professor J. H. C. Coffin, of the *Nautical Almanac* Office, stationed at Burlington, Iowa.

The instrument employed was a spectroscope with 5 prisms of 45° each, having faces 2¼ by 3¼ inches; the collimator and telescope had apertures of 2¼ inches, with a focal length of 17. These were connected with a "comet seeker" of 4 in. aperture and 30 in. focus, used with an eye-piece, and giving an image of the sun, 2½ inches in diameter, on the slit of the spectroscope. A graduated screen at the slit determined positions of points on the sun's limb, and a wire micrometer measured the positions of spectrum lines. The whole was mounted equatorially with slow motion screws.

Protuberances were noted before the eclipse at + 85° to 100°, large and not very bright; at + 146°, small and bright. The photographs show another at 155°, which escaped notice; also at − 70° to 80° low, but pretty bright; and at − 130°, very large and bright, the principal one. Angles are reckoned on the sun's limb from the North point, + towards the East, − towards the West.

The first contact was observed by watching the gradual shortening and final extinction of the *bright line*, C, in the spectrum of the prominence, which happened to be at the point of contact. The moon's approach was perceived full thirty seconds before its actual appulse; the observation was perfectly easy, and the time determined is certainly to be relied on within half a second, and probably much less. The presence of a prominence at the point of contract is not essential to the success of the method, as there is everywhere on the sun's limb sufficient depth of chromosphere to answer the purpose.

It is proposed to apply the spectroscope to observations both of the external and internal contacts at the next transit of Venus.

During the totality, the following nine bright lines were observed in the spectrum, viz., C, dazzling in brilliance; 1017·5 (near D, the numbers refer to Kirchhoff's scale,) very bright, but not equal to C; 1250±20, very faint, position only estimated; 1350±20, like the preceding; 1474 (a little below E,) conspicuous, but not more than half as bright as 1017·5; F, next to C in brightness; 2602±2, a little fainter than 1474, position determined by micrometrical reference to the next; 2796, a little below G, the well known Hγ line in brightness between 1017·5 and 1474; and finally *h*, or Hδ, somewhat brighter than 1474. *b* was not seen, it is supposed, on account of a mistake in carrying that portion of the spectrum through the field while there was no prominence on the slit.

* The line 1474 was recognised as belonging to the *spectrum of corona*, in the first place, by its extending clear across the spectrum, while 1017 did not, and then by its remaining visible when the slit was moved away from the protuberance, while the other lines (C and 107) disappeared. The impression of the observer is that faint lines 1250 and 1350 behaved in the same manner, but his recollection as to this point is not very certain.

These three lines, 1250, 1350, and 1474, coincide far within the probable errors of observation with three lines observed by Prof. Winlock in the spectrum of the Aurora Borealis. The first two are not accurately enough determined, in position, to allow much stress to be put upon any apparent coincidences on their part, but the last is perfectly well known, and its exact agreement throughout with one of the fainter lines of the Aurora, when combined with the general appearance of the Corona and other considerations, give a good deal of probability to the conjecture that *our Aurora Borealis and the Solar Corona are identical phenomena*.

The line 1474 is given by both Kirchhoff and Angström (not by Huggins, who, however, omits many faint lines,) as belonging to the *iron* spectrum, and this

* A careful examination of the photographs of the prominences on the eastern limb of the sun, upon which the slit of the spectroscope was directed during the first half of totality, somewhat diminishes my confidence in the conclusion of the text, as to the nature of these three lines. I think it absolutely certain that they do not belong to the spectrum of the *brilliant portion* of the prominences; but the photograph shows, in addition, an extensive nebulosity surrounding the nuclei, with a pretty definite boundary of its own. This nebulosity is best seen in No. 2 of the totality pictures taken at Burlington. Now, it is *possible* that these lines may belong to this *nebulosity*, and not to the *corona proper*; for I cannot recall, with certainty, whether the 1474 line retained its brilliance at any considerable distance from the prominences. My impression is that it did, and that the text is correct, but do not wish to be too positive. The eclipse of December, 1870, will decide, of course.

suggests the inquiry whether we are to admit the existence of *iron* in the auroral heights of our atmosphere, or are to account for this line in the iron spectrum by some unknown substance of gaseous nature.

The corona showed, also, a faint continuous spectrum without *any trace of dark lines.* The light of this faint spectrum, tested by a tourmaline held in the hand next the eye, was strongly polarised in a plane passing through the sun's centre. As the direction of the spectroscope slit was nearly radial, it is not impossible that Prof. Pickering may be right in explaining this polarisation as caused by the successive refractions through the prisms.

Professor Young's Determination of First Contact.

In our notice of this subject we omitted to state that Prof. Young finds that the presence of a prominence at the point of first contact, though facilitating the process, is not essential to his method, since the spectrum of the chromosphere is quite enough for the same purpose.

The Corona and its Photographs.

It is a very fortunate thing that the numerous parties by whom photographs were made of the late eclipse, in hardly any two instances followed the same plan of arrangement or aimed at the same class of results. Thus, the Philadelphia Expedition, in pursuance of Professor Coffin's suggestions, made their preparations with the view of obtaining such "accurate and well-defined pictures as might be the basis of astronomical calculations." In this they have unquestionably succeeded beyond all others, as we hear from all sides, now that pictures have been distributed and compared. Their views of lunar mountains, sun-spots, faculæ, chromosphere, and erepuscule being unapproached, and their views of the solar prominences only rivalled by one obtained by Dr. Curtis.

The party under Prof. Pierce, consisting, photographically, of Mr. Whipple, of Boston, (who, with Mr. Black and the late Prof. Bond, of Cambridge, made, in 1850, the first celestial photograph), addressed themselves exclusively to the recording of that strange phenomenon, the corona. To secure any impression from this object, which, notwithstanding its apparent brightness is remarkably deficient in photographic power, it was necessary to make a very small image, and to give a very long exposure.

The telescope was therefore arranged to produce an image in its principal focus simply, and during the totality an exposure of 40 seconds was given. By this means a picture was obtained, of which the accompanying cut is a very careful copy. From the long exposure

and motion of the moon, as also, probably, of the light in the corona, there is little sharpness of definition, and the prominences only appear as bright spots. The general shape of the corona is, however, very well given, and the curious appearance of curvature, in some parts, is very manifest. This and other pictures—if others than the one we have seen were made—may throw some light upon this extraordinary object.

ON RAISING A HIGHER TEMPERATURE IN CERTAIN SOLUTIONS BY STEAM OF 212° FAHR. (100° C.).

BY PETER SPENCE, F.C.S.

Some twelve to fifteen years ago, the author had occasion to require large masses of liquor to be raised to a temperature of 228° F. (108·8° C.), for the purpose of extracting, by means of long-continued digestion at that heat, of alumina, in the form of sulphate of alumina, from minerals containing that earth. As time was an element of importance in his calculations, the author's aim was to heat the liquors as rapidly as possible; but lead vessels only could be used with the acid liquors; and, as it was requisite to have an iron outside vessel next the fire, the heating was a tedious operation. To overcome this loss of time, the author fitted up a digesting vessel, so as to raise the heat rapidly to 212° F. (100° C.), by injecting steam from a steam boiler into the mass of liquor; and as soon as he had obtained that temperature, he stopped off the steam, and allowed the external fire to operate alone, so as to raise the additional 16° F. (8·8° C.) required, and to maintain the temperature at 228° F. (108·8° C.), his impression being that, above 212° F. (100° C.), the steam, if kept on, would act as a cooling agent, and prevent the temperature rising. The combined operation was perfectly successful, and went on for some time, acting, as the author supposed, in accordance with his pre-conceived theory; but some circumstances led him, subsequently, to doubt whether it was so. He found that if, inadvertently, both steam and fire were left acting after the higher temperature was obtained, the temperature continued, notwithstanding. Again, when the fire was in a condition, through neglect, in which it was obviously of no use, the author was still astonished to find that, as the apparent result of the steam alone, the temperature was at a satisfactory point. This last observation led the author to test the matter in the laboratory in the following manner:—Being convinced that the high boiling point of his liquors had something to do with the phenomenon, he selected a solution of a salt (nitrate of soda) having a high boiling point—about 250° F. (121·1° C.). The nitrate of soda was placed in a vessel surrounded by a jacket; steam was let into the intervening space, until a temperature of nearly 212° F. (100° C.) was obtained; the steam was then shut off, and an open pipe immersed in the solution, and steam from the same source was thrown directly into the liquor; in a few seconds, the thermometer slowly but steadily moved, and minute after minute progressed, until it touched 250° F. (121·1° C.). This thoroughly explained the results obtained in the digesting vessel, and became to the author of immense practical value. He discarded the use of fire applied to his vessels, which had not only been tedious and troublesome in operation, but involved a loss of many hundreds of pounds per annum in destruction of apparatus, and used only steam as a vehicle of heat. As a corroboration of the theory,

which seems to explain the apparent paradox, the author finds that the temperatures of his solutions are in the exact ratios of their specific gravities, and have no connection with the temperature of the steam, which never exceeds 212° F. (100° C.). The greater the specific gravity of his acid solutions, the higher the boiling point; and, therefore, whatever the boiling point of the solution in water of any salt, to that point, or nearly, will steam of 212° F. (100° C.) raise it.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, November 4th, 1869.

Sir Benjamin C. Brodie, Bart., F.R.S., *in the Chair.*

The minutes of the previous meeting having been read and confirmed, the following certificates were read :—

For the first time—Sir Roderick Impey Murchison, Bart., Belgrave Square; John Wiggin, Pharmaceutical and Analytical Chemist, Ipswich; George Harrison, Analytical Chemist, 26, Havelock Square, Sheffield; Thomas Walton, M.R.C.S., and L.S.A., Lecturer on Chemistry at the Hull and East Riding School of Medicine, Kingston-upon-Hull; Edward Smith, Practical and Pharmaceutical Chemist, Strand, Torquay; G. Manley Hopwood, 22, Grosvenor Square, All Saints, Manchester; Thomas Gibb, A.R.S.M., Engineer; Matthew H. Cochrane, 108, Paul Terrace, Glasgow.

For the second time—E. S. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

For the third time—Alfred Dudley Keightley, Gatcheck Gunpowder Mills, Old Hall, Milnthorpe, Westmoreland; W. Fletcher Barrett, Lecturer on Physical Science at the London International College; John Morrison, Analytical Chemist, County Wicklow, Ireland; Temple A. Orme, Teacher of Chemistry and Experimental Physics in University College School; W. G. Lewis, Fellow of Oriel College, Oxford.

The last-named gentlemen were ballotted for and duly elected. Mr. Gerstl was elected an Associate of the Society.

The Chairman said the first business before the Society was to consider a paper "*On the Atomic Theory,*" which had already been read before the Society by Professor Williamson. This theory was not to be regarded as a fixed and definite system of ideas, but one that had undergone great variation and change. There was the atomic theory of Dalton; then that of Berzelius, and also, in a certain sense, that of Laurent and Gerhardt; and now they had come to a further form of this theory, in which new ideas had arisen in regard to the nature of atoms and their properties; and he (the Chairman) thought it would greatly facilitate the discussion if Dr. Williamson would explain what was the precise form of the atomic theory which he was prepared to maintain and defend, and how they might discriminate that from other forms of the theory which were neither reasonable nor rational. First, there was the question whether there were atoms at all; then, being atoms, what those atoms were, and whether they were endowed with the properties assigned to them in regard to their replacing power, and to what was termed their value.

Professor Williamson, on rising, said that he did not admit that, among chemists, there had been several atomic theories. If there had been, he had yet to learn of them. There had prevailed, he believed, from time immemorial, a belief that matter was built up of small particles; and he might also say that no contrary opinion had ever been embodied in any definite form. Dalton doubtless looked for evidences of what he believed to be true, and saw, in the simple multiple proportions which he specially alluded to, facts which were in accordance with that preconceived conviction; but his was the mere germ of an atomic theory, and the changes which have taken place in it since are consistent with the original notions. The very rapid changes had, in the main, been additions to the starting-point given by Dalton. The line of work so vigorously pursued of late years by many chemists, regarding the order in which atoms are arranged in their compounds, was mentioned by the speaker. His endeavour had been to put together more fully than had been done of late what is known of the chemical evidence; firstly, respecting the limits to the divisibility of matter, and, secondly, with regard to the properties of those finite particles which constitute the limits of divisibility, solely from the point of view habitually employed by chemists in their ordinary working. He had also endeavoured to separate those conclusions which appeared to him warranted by facts from everything else. Whether the smallest particles of matter had a spherical form or not, whether they were in their nature indivisible, whether they were in reality the ultimate atoms of matter, or like the planets of this system, he knew not, nor did such questions exist for him as a chemist. He therefore thought it wise to exclude them, important as they were, from the actually existing atomic theory. The work of Berzelius was perhaps the most significant transition from the original notion of Dalton. Silently these atoms had been accepted by chemists, and the whole course of investigation had been one grand confirmation of the assumption that compounds must have molecular weights corresponding to at least the smallest atomic proportion which would represent the actual numbers of analysis. The perfectly independent observations which had been made in reference to the boiling-points of homologous liquids, the phenomena of diffusion, the equality of volumes of masses containing an equal number of these molecules under similar conditions in the gaseous state, all concurred to corroborate the conclusions necessitated by the atomic theory. Thus, independent workmen hewed stones which, when hewn, were found to fit in exactly with the others, forming a perfectly homogeneous whole. Dr. Williamson concluded his remarks by referring to the atomic values, a term which, he thought, represented in a more precise way than some others what is called atomicity; and he also referred to the difference between direct and indirect combination, a fact which he conceived to be essentially atomic in its nature.

Dr. Frankland was not present when Professor Williamson delivered his lecture, and he had only cursorily looked over the printed memoir; but, so far as he could gather, the object of the author had been to establish the atomic theory as an absolute truth. There had been, he thought, so little, if any, opposition to the application of the atomic theory to the phenomena of chemistry, that a discussion could scarcely be raised upon any other feature of the question than that of its absoluteness. He considered it impossible to get at the truth, as to whether matter was composed of small and indivisible particles, or whether it was continuous—the question belonged to what metaphysicians termed "the unknowable;" but he acknowledged the importance of the fullest use of the theory as a kind of ladder to elevate the chemist from one position to another in his science. He was, however, averse to accepting the theory as an absolute truth. Any attempt to realise by its help the action of attractive or repulsive forces upon matter was excessively difficult; indeed to realise such an action through a perfectly void space was to him quite impossible. The same difficulty presented itself to Faraday, who was often obliged to throw on one side, as an obstacle to his progress, this atomic theory. He said that if matter be assumed to be thus composed of solid particles separated by a void space, then, in considering the phenomena of electricity in connection with that view of matter, this space existing between the atoms must be either a conductor or a non-conductor of electricity. If a conductor, such a thing as an insulator was obviously an impossibility; if it was a non-conductor, such a thing as a conductor was equally incon-

ceivable; so that, apart from chemistry, there were considerations which made it very undesirable for this theory to be represented as an absolute truth. The speaker then referred to the combination which, in certain cases, is effected between gases by the application of heat, and said that, according to the atomic hypothesis, they must assume that the gases, when heated, have their particles driven further asunder; but how, then, could they more readily enter into combination when heated, as was the case with oxygen and hydrogen, and in many other similar instances? No such difficulty presented itself if the gases were regarded as continuous matter. He admired the theory as much as Professor Williamson, and he thought no one could blame him for not making a sufficient use of it; but he did not wish to be considered a blind believer in the theory, or as unwilling to renounce it if anything better presented itself to assist him in his work.

Dr. Odling, as a chemist, was not particularly interested in the question whether matter was infinitely divisible or not, but he did not think that Dr. Williamson's argument had established that conclusion. Dalton was always spoken of as the discoverer of the law, or doctrine, or theory of combination in definite and multiple proportions, to account for which his invention or adoption of the atomic theory was founded; and he conceived Dalton's great discovery to be better expressed as the law of combination in *reciprocal* and multiple, instead of in *definite* and multiple, proportions. Dr. Williamson had said of chemists that all their modes of thought, and all the government of their actions, was based upon the atomic theory; but he (Dr. Odling) maintained that it was based upon the observed fact that certain bodies combined in certain proportions. Dr. Williamson also argued that the atomic theory was based upon the existence of molecules, and that molecules had no *locus standi* in the absence of the atomic theory. He (Dr. Odling) disputed that position, for the fact that the hydrogen existing in marsh gas was divisible into four parts, and the hydrogen existing in ammonia only into three parts, was, he conceived, a fact quite independent of the atomic theory. The laws of combination, as far as they go, were compared by Sir Humphry Davy to Kepler's laws of planetary motion, which were simply a general expression of observed facts; and, in the same way, these laws of chemical combination were general expressions of observed facts upon which the atomic hypothesis was super-induced.

Professor Miller thought that Dr. Odling's arguments had not disproved the atomic theory; if they had not the atomic hypothesis, they were entitled to ask what explanation they possessed of the laws of combination? Certain facts were admitted on all hands, as determined by experiment, and when an important and extensive series of facts was ascertained, the endeavour to explain them by some supposition which embraced the facts, and which enabled them to anticipate new ones if possible, was a necessary result of their mental constitution. Unless some hypothesis were accepted, it was absolutely impossible to reason upon the facts; and if they could not adopt this hypothesis as absolutely true, such a view of the constitution of matter explained all the chemical facts that had hitherto been presented. It appeared to him that those who denied the atomic hypothesis were bound to supply something to enable them to interpret phenomena with the same regularity and order as the hypothesis, the accuracy of which they denied and desired to displace. No one would suppose that the absence of an undulatory theory for light would conduce to the explanation of optical science; and he held that what the undulatory theory was to the phenomena of light, the atomic theory was to the phenomena of chemistry.

Professor Foster thought the question before them was not so much the utility of the atomic theory as its truth. M. Naumann had stated, in his "Relations of Heat to Chemistry," that, if we assumed that in any compound body the components really occupied distinct positions of space, they must assume that body to be incapable of infinite divisibility. He thought the ideas generally entertained of the existence of the constituents of bodies in compounds were not absolutely necessary ideas. The fundamental phenomena of chemical changes might sometimes be explained by returning to the notion of the actual mutability of matter. By operating upon one portion of matter, it was actually transmuted into another, a qualitative and quantitative relation existing between the disappearing and the appearing bodies. From such ideas as these, they could not deduce the necessary existence of atoms; but all our present modes of expression and modes of thought were founded upon an atomic hypothesis or basis.

Professor Tyndall sympathised with the ideas of Professor Williamson; his thoughts had, to some extent, been expressed by Dr. Miller, who had made a strong point in referring to the undulatory theory. That theory was something superinduced upon the facts, which might be readily detached from the theory. But it was in the nature of the human mind, it was in the nature of a profound thinker, when pondering upon facts of this nature, to seek for some underlying principle outside the region of facts, from which the facts followed as consequences. Dr. Odling ought to have gone a step further than Kepler; for something that we now call "the theory of gravitation" was certainly superinduced upon his facts, as the atomic theory is upon the facts of multiple proportions. Professor Foster had justly referred to the consideration that a bad theory was very often useful. The emission theory of light was useful in the hands of Newton, Laplace, Malus, and Brewster; but this theory fell, because, in the progress of investigation, facts arose which were inexplicable by it, and which were completely explained by the undulatory theory. The undulatory theory would successfully front all opposition as long as it was competent to explain the facts of optics; and he apprehended that the atomic theory would stand as long as it was competent to explain the facts of chemistry.

Dr. Mills' conviction was that chemistry had no facts to support the notion of a limit, and the undulatory theory had an immense advantage over the atomic theory, for the existence of waves was a fact, while the existence of a limit was not a fact. It seemed to be forgotten by many writers that matter might be infinitely divisible, and yet that definite proportions might exist, for between two infinites there might be a finite ratio, so that the atomic theory was not perfectly necessary to chemistry He believed that motion was the highest generalisation of modern science, and it therefore afforded the only criterion by which all theories, including those of chemistry, must be judged, and the notion of a limit was practically inconsistent with the idea of a motion.

Dr. Williamson, in his reply, remarked that the benefit accruing from looking at the question from another point of view would be incalculable, and if another view was developed to supersede the present one, he would be among the first to rejoice at it, but he had not to do with the future of this matter. He had endeavoured to put together the actual evidence of the present view, and none of its opponents had been able to find a fallacy in that evidence. He thought it most important to keep the theory at each period of its growth in the modest position which it at present occupies, that of generalising the best-ascertained relations of the elements in their chemical changes.

The Chairman liked to have clear and definite ideas, as far as he was able to realise them, on scientific subjects, and he was unable to consider even an atomic theory in the abstract. The atomic theory, as he understood, was—that matter is made up of finite particles, the aggregate of which could be divided and subdivided until at last only one particle would remain, and this view might be derived from the perusal and common assent of every work on chemistry that defined the atomic theory. He thought that such a view as the physical indivisibility of matter must be separated from the facts and basis of chemistry. Dr. Williamson seemed to think the theory and facts were one, but he

(the Chairman) asserted that they were two distinct things. He must also express his dissent from the views expressed by Drs. Frankland and Miller, with reference to the use of a doctrine or theory in which they did not believe. He could not understand using a theory and denying it at the same time. This theory had, he thought, been often the means of deluding chemists into the belief that they understood things about which they knew nothing. He found the works of Kekulé and Naquèt scribbled over with pictures of molecules and atoms, combined together in all imaginable ways, for which he thought there was no adequate reason, and if there was no reason it was a mischievous thing to do. Many students, he believed, thought the pictures in Naquèt's work were chemistry; they did not draw the distinction between the facts and theory of science. His view was that the ultimate constitution of this material universe was one of those things upon which no light had yet been thrown, and he agreed with Dr .Odling when he said that the science of chemistry did not require or prove the atomic theory. They were bound to have some real and adequate means of working at the science of chemistry, and discovering its laws, and they could effect this either through the investigation of the laws of gaseous combination or the study of the capacity of bodies for heat. When they approached the science through the study of gaseous combinations, they discovered that the combining proportions of bodies were capable of being represented by integral numbers, and they also found an analogous fact in studying the capacity of bodies for heat.

The meeting was then adjourned to November 18th.

Thursday, November 18th, 1869.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time—Samuel Jefferson, Secretary to the Yorkshire Board of Education, Woodville Terrace, Woodhouse Lane, Leeds; Clements Higgins, Demonstrator of Chemistry, King's College, London; James John Bourey, Analytical Chemist, 10, Stepney Causeway, E.

For the second time—Matthew H. Cochrane, 108, Paul Terrace, Glasgow; Edward Smith, Practical and Pharmaceutical Chemist, Strand, Torquay; Thomas Walton, M.R.C.S., and L.S.A., Lecturer on Chemistry at the Hull and East Riding School of Medicine, Kingston-upon-Hull; G. Manley Hopwood, 22, Grosvenor Square, All Saints, Manchester; John Wiggin, Pharmaceutical and Analytical Chemist, Ipswich; Thomas Gibb, A.R.S.M., Engineer; George Harrison, Analytical Chemist, 26, Havelock Square, Sheffield; Sir Roderick Impey Murchison, Bart., F.R.S., Belgrave Square.

For the third time—E. S. Blackwell, Analytical and Consulting Chemist, 6, St. Sacrament Street, Montreal, Canada.

The last-named gentleman was balloted for and duly elected.

At the request of the President, a paper by William Dittmar, F.R.S.E., and George Cranston, "*On the Formation of Carbonic Ether*," was read by the Secretary.

The authors referred to Ettling's researches upon the action of sodium or potassium on oxalate of ethyl, and had endeavoured to discover the *rationale* of that action. They found that, when ready-formed sodium ethylate (ENaO) is brought into contact with oxalate of ethyl, the former compound, like the metal itself, causes the formation of carbonic ether and carbonic oxide. Dry ethylate (ENaO) was prepared by evaporating the liquid alcoholate in a current of dry hydrogen in a retort heated in an oil-bath, when the compound remained as a white porous mass. On treating dry ethylate with about eight times its weight of oxalic ether, it dissolves, and a yellowish syrup is formed, which sometimes gelatinises on standing. If this mixture is gradually heated, at about 80° C. large quantities of gas (chiefly carbonic oxide) are evolved, and the mass darkens till it is almost black. At 140° the reaction ceases. The mass is then distilled at a temperature not exceeding 200°; and the distillate consists of carbonate of ethyl, sometimes mixed with undecomposed oxalate, and always contaminated with ethylic alcohol. The black residue dissolves in water, and contains oxalate and formiate of soda, and also the soda salts of some complex organic acids. Experiments in order to obtain a basis for the speculation on the nature of the reaction led to the following conclusions:—"ENaO" parts of ethylate, acting upon an excess of oxalic ether, decompose 4 "$(EO)_2C_2O_2$" parts of oxalate of ethyl, and produce 3 "$(EO)_2CO$" parts of carbonate of ethyl, 3 "CO" parts of carbonic oxide, and about 0·4 "EHO" parts of alcohol. The behaviour of dry ethylate of potassium on oxalate of ethyl was qualitatively analogous to that of sodium ethylate; the reaction is, however, more energetic, and begins at a lower temperature.

The President said they were indebted to the authors for their interesting communication. It was remarkable that those bodies should effect the same decomposition as had been observed with the metals themselves; and he hoped the authors would follow up the reactions, so as to show the phases of which they consisted.

Professor Wanklyn said that he had read a paper to the Society in 1864, on "The Constitution of the Ethers of the Fatty Acids," and in it he regarded the ethers as compounds, in which the acid-forming radical was the metal, and the ethyl oxide the chlorous radical. He also presented a paper on the reaction treated of by the authors, and predicted that ethylate of sodium would decompose oxalic ether, and produce carbonic oxide and a carbonic ether, and that an unlimited quantity of oxalic ether might be decomposed by a given quantity of ethylate of sodium; but the paper was not published by the Society. It was gratifying to him to find his prediction verified so long afterwards by gentlemen who had made the experiment without any communication with, and quite independently of, himself.

"*On the Dissociation of Liquid Sulphuric Acid*," by W. Dittmar, F.R.S.E., was then read.

In the opinion of the author, the experiments of Marignac on this subject seemed to show that "H_2SO_4" exists as a definite chemical individual only in the solid state, and that H_2SO_4, even at low temperatures, must be regarded as a molecular mixture. To determine which chemical individuals they were to assume to be present in the mixture, Mr. Dittmar investigated the behaviour of the acid H_2SO_4 when boiled under pressures differing from the atmosphere. The apparatus used for this purpose consisted of a retort, hermetically connected with the receiver, which communicated with an air-pump so constructed as to serve the purpose of rarefying as well as condensing. The results proved the residues obtained to be almost identical in composition with Marignac's acid. As the acid first subjected to distillation was only a little stronger than the product obtained, it was fair to assume that a further concentration of the residue would not have led to any further change in its composition. Sulphuric acid, when boiled down under any pressure between 3 c.m. and 314 c.m., behaves almost like a mixture of the stable hydrate $12SO_3 13H_2O$ + excess of SO_3, but the existence of a stable *molecule* of this composition could not be deduced from this fact. The observed facts could be accounted for without denying that in liquid sulphuric acid, even at its boiling point, the majority of the molecules have the composition H_2SO_4. It was known that 'H_2SO_4' vapour consists chiefly of isolated molecules of SO_3 and H_2O; and it was in accordance with Clausius's theory to assume that in liquid sulphuric acid, even at low temperatures, a number of the molecules have assumed the state of motion corresponding to a temperature beyond that of dissociation. The higher the temperature, the greater the ratio of the number of the dissociated molecules to that of the unchanged ones. The liberated H_2O's and SO_3's being formed in the midst of a mass of (H_2SO_4)'s will, probably, mostly unite with compara-

tively cold molecules of H_2SO_4, and form compounds $H_2SO_4+H_2O$ and $H_2SO_4+SO_3$ respectively; supposing the latter compound to be less stable than the former, it is easily understood that, in the distillation of sulphuric acid, the higher the temperature, the more SO_3 will predominate in the vapour.

Professor A. H. Church, M.A., then read a communication on "*Namaqualite.*" This mineral occurs in Namaqualand, South Africa, in thin layers of silky fibres, which are true crystals. It is of a pale blue colour; its density is 2·49. Isolated crystals appear transparent under the microscope. In the closed tube it gives off much water, when heated becoming black. The mean percentages deduced from the analysis of five specimens are as follows:—

H_2O	32·38
CuO	44·74
Al_2O_3	15·29
CaO	2·01
MgO	3·42
SiO_2	2·25
	100·09

Regarding the silica as an intruding substance, and the lime and magnesia as replacing a small part of the cupric oxide, the author thought the mineral might reasonably be considered as a compound of 4 molecules of cupric hydrate, 1 molecule of aluminium hydrate, and 4 molecules of water. The oxygen ratio between the protoxides, the aluminium oxide, and the water, is 4 : 3 : 11 nearly, and corresponds to such a view. The mineral belongs to the rare class of hydrous oxides, in which a protoxide and sesquioxide are united. The fact that it is crystallised, as well as definite and constant in composition, demands for it specific rank.

"*Chemical Researches on New and Rare Cornish Minerals (No. 6.)—Hisingerite,*" by Prof. Church, M.A. Under this name the author provisionally describes a brown amorphous mineral found in Cornwall. Its chief characteristics are as follows:—Amorphous; reniform; fissured; dark brown; streak, pale; rust, brown (in some specimens, olive-brown); fragile; fracture, irregular conchoidal; hardness, 2·75; density, 1·74. Before blowpipe in closed tube much water, having faint permanent acid reaction. On charcoal, decrepitates and becomes black. Fuses with difficulty in outer flame to a red brown bead. Boiled in acids leaves a siliceous skeleton.

The mean percentages deduced from three analyses run thus:—

Fe_2O_3	52·94
SiO_2	36·14
H_2O	10·49
	99·57

The mineral also contained 0·82 per cent of P_2O_5 and traces of magnesia.

"*On Chloranil and Bromanil*" (No. II.*), by Dr. Stenhouse, LL.D, F.R.S., &c.

When phenol was acted upon by chloride of iodine in the presence of water, it yielded a brown crystalline mass, from which chlorinal was obtained. Red oil, obtained in the ordinary process for preparing chloranil, dissolved in a dilute boiling solution of caustic soda, a sufficient quantity of potassic chlorate, and hydrochloric acid, yielded small crystalline scales, consisting of chloranil and terchlorquinone. When the red oil was digested with nitric acid, sp. gr. 1·36, red fumes took place. Chloropicrin distilled over; chloranil remaining in the retort.

Chloranilic Acid was prepared as follows:—Five parts of chloranil, moistened with alcohol, were added to a cold solution of 6 parts of potassic hydrate in 150 of water; the mixture occasionally stirred till the yellow scales disappeared and part of the potassium salt had crystallised out in dark red needles. The chloranilic salt is precipitated by adding from 10 to 15 parts of chloride of sodium; it is then washed with a solution of common salt, and purified by one or two solutions in boiling water, precipitations by common salt, and a final crystallisation from distilled water. The chloranilate is then dissolved in 100 parts of boiling water, and 10 parts of hydrochloric acid is added; on cooling, the chloranilic acid is deposited.

The alkaline chloranilates are prepared by neutralising pure chloranilic acid with the corresponding alkaline hydrate or carbonate.

Chloranilic ether, $C_6Cl_2(C_2H_5)_2O_4$.—One part of chloranilate of silver is digested with five of ethylic iodide until the silver salt is converted into iodide, the excess of iodide of ethyl distilled off, and the chloranilic ether extracted by boiling alcohol.

The action of chloride of iodine on chloranilic acid gave large transparent plates, which were found to be oxalic acid, and a heavy oily layer, which the author is at present investigating. The author is also investigating the action of bromine on chloranilic acid; he has already obtained a substance corresponding closely to $C_6Br_6Cl_3HO$.

Bromanil.—To prepare this substance, Dr. Stenhouse places bromine in a flask with one-third of its weight of iodine and five times its weight of cold water. On adding phenol through a long digestion tube, a strong reaction takes place; the phenol adhering to the side of the tube is then washed down with five parts more boiling water, and the whole digested for one or two hours at 100° C. When cold, the semi-solid contents are freed from the mother liquor with a Bunsen's vacuum filter, and digested with bisulphide of carbon to remove terbromophenic acid. Tolerably pure bromanil remains.

When bromanil was digested with hydriodic acid and phosphorus, bromhydranil, $C_6Br_4O_2H_2$, was obtained. The author also procured terbromhydroquinone and terbromquinone from the action of sulphurous acid on bromanil.

Bromanilic acid was prepared in a similar manner to chloranilic acid.

Bromanil phenylamid was prepared by adding an excess of aniline to bromanil dissolved in benzol, and washing the almost black crystalline plates with boiling alcohol.

The author concludes with an account of the action of bromine on bromanilic acid.

The President, in thanking Dr. Stenhouse for his interesting communication, referred to the beautiful specimens of some of the compounds described which have been sent to the Society by Dr. Stenhouse.

"*On the Salts of Acetylinated Ethyl,*" by J. Alfred Wanklyn.

The liquids having the empirical formulæ $C_6H_{10}O_3C_6H_{14}O_3$, and $C_{10}H_{18}O_3$, respectively, and which were discovered by Geuther, and Frankland and Duppa in the course of their researches on acetic ether, and to which a variety of names have been assigned by their discoverers, have been found to be, in reality, the salts of the new organic radical, "acetylinated ethyl." They show two characteristic reactions—With ethylate of sodium they yield salts of common ethyl, the acetyl being exchanged for hydrogen thus:—

Butyrate of acetylinated ethyl

$$\overbrace{\left.\begin{matrix}C_2H_4(C_2H_3O)\\C_4H_7O\end{matrix}\right\}O}+\left\{\begin{matrix}C_2H_4Na\\H\end{matrix}\right\}O=\left\{\begin{matrix}C_2H_5\\C_4H_7O\end{matrix}\right\}O+\left\{\begin{matrix}C_2H_4Na\\C_2H_3O\end{matrix}\right\}O$$

With baryta water, they give alcohol, a ketone, and carbonate of baryta—

$$\left.\begin{matrix}C_2H_4(C_2H_3O)\\C_4H_7O\end{matrix}\right\}O+\left\{\begin{matrix}Ba\\H_2\end{matrix}\right\}O_2=\left\{\begin{matrix}C_2H_4H\\H\end{matrix}\right\}O+\left\{\begin{matrix}C_2H_3O\\C_3H_7\end{matrix}\right\}+\left\{\begin{matrix}Ba\\CO\end{matrix}\right\}O_2$$

* For the author's first paper on this subject, see Chemical News, vol. xvii., p. 129 (*Am. Reprint, May, '68, page 237*).

wherein H_2 replaces acetyl and butyryl, and the latter do not form acetate and butyrate of baryta, but a ketone and carbonate of baryta, being an example of the common method of producing ketones, but at the temperature of the water-bath instead of at a low red-heat.

The Society then adjourned till Thursday, December 2nd.

We have received the following letter from Professor Wanklyn, respecting his researches on the subject of Messrs. Dittmar and Cranston's memoir:—

To the Editor of the Chemical News.

Sir,—The paper suppressed by the Chemical Society in the year 1864, to which reference was made in the course of the discussion of Mr. Dittmar's admirable research "On the Production of Carbonic Ether," was a short note on that subject, and was intended to form an appendix to my paper "On the Constitution of the Ethers." In this note I expressed the belief that the production of carbonic ether was due to the action of ethylate of sodium on oxalic ether, and that the reaction would be found to belong to the class of so-called catalytic actions. These predictions were made avowedly in virtue of the general views of the structure of the ethers which were then entertained by me, and were, in my opinion, useful as tests of the validity of those theories, and also as illustrative of their nature and meaning. The authorities of the Society, however, appear to have entertained a different opinion, and, out of a tender regard for my reputation as a chemist, suppressed the note.

On referring to the report in the Chemical News (vol. x., p. 233, *Eng. Ed.*), I find the following passage at the end of the abstract of my paper on the ethers:—"An explanation of the formation of carbonic ether from oxalic ether was also given." The note itself has, I believe, never been published, but was referred to by me in a paper "On Formic Ether" (see Chemical News, vol. xvii., p. 144 [*not to be found: Am. Ed'r.*]).

At that period, I was unprepared for such an exercise of paternal solicitude on the part of the officers of the Society, and took no steps to avoid suppression. In more recent times, I have always been in readiness to resist dictation of this sort, and, though frequent attempts have been made on the part of the Society to suppress papers either of my own or of my former colleagues, have never submitted to the smallest suppression. The practical result has been that which might have been anticipated, viz., the scattering of my papers through different journals; and, if chemists should hereafter complain that what I have written on a given chemical subject is not all of it to be found in the pages of the *Chemical Society's Journal*, but is diffused through the scientific press, the fault lies with the officials of the Society, and not with me.—I am, &c.,

J. Alfred Wanklyn,
Corresponding Member of the Royal Bavarian Academy of Sciences.

London, Nov. 20th, 1869.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

The opening meeting of the session was held on Monday, the 8th instant, when Dr. Wallace, F.R.S.E., F.C.S. Vice-President, in the absence of Professor Anderson, the President of the section, delivered an address.

Dr. Wallace congratulated the members of the section upon the success which had attended their meetings during the two previous sessions, and hoped that during the present winter they would give the office-bearers of the section their cordial support in endeavouring to promote the prosecution of scientific and applied chemistry in Glasgow. The Chemical Section had been a valuable feeder to the Philosophical Society, and had been a means of encouraging the formation of other sections, as well as stimulating the enterprise of chemists in other centres of manufacturing industry. The speaker then referred to the subject of technical education and the necessity for the establishment of chairs of technical chemistry in our universities. With regard to the munificent offer of Mr. James Young, to found a chair of technology in connection with the Andersonian University, much sympathy was felt for the eminent professor of chemistry in that institution, but they all must regret that they had not amongst them so able a man and so diligent a worker as the gentleman who had been chosen to fill the chair. It was announced, however, that Mr. Young intended to form an independent school of chemistry in Glasgow. Dr. Wallace then gave a sketch of the life and labours of the late Mr. Graham, Master of the Mint, and gave an abstract of his most recent researches on hydrogenium.

The remainder of the address was occupied with a review of the latest contributions to theoretical and applied chemistry.

The next meeting of the section will be devoted to the election of office-bearers and other business matters.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

A meeting was held on Monday evening, the 22nd inst., Dr. Wallace, F.R.S.E., Vice-President, in the chair.

The following four gentlemen were elected Members of Council, in room of four who retired by rotation:—James Anderson, Esq., 98, St. Vincent Street,; Dr. John Clark, Anderson's University Laboratory; James Couper, Esq., St. Rollox Chemical Works; P. M. Moir, Esq.

Dr. Wallace then made some remarks on the results of his examinations of some waters taken from cisterns in the vicinity of water-closets, in various parts of Glasgow. He stated that the results of his observations, which were made conjointly with Dr. Anderson, went to show that there was not a trace of any gas present which could arise from the decomposition of animal matter. A microscopic examination did not show the presence of any insoluble matters other than ordinary dust.

A new and very different source of danger, however, was revealed by the analyses. It was found that water which had got warm by remaining in pipes which were exposed to warmth, either by proximity to the usual hot-water pipes or otherwise, was frequently contaminated with lead to such an extent as to render the use of the water for dietetic purposes positively dangerous.

NOTICES OF BOOKS.

Nature: "*A Weekly Illustrated Journal of Science.*" Macmillan and Co., London.

We are glad to notice the birth of a new popular journal of science. It was never more wanted than now, for it is undeniable that at no previous period has there been such a manifest desire on the part of the general public to understand somewhat of the great scientific discoveries and generalisations which are perpetually springing up around us. Among the objects proposed to be attained by "Nature," is the urging "the claims of science to a more general recognition in education and daily life," and we are fain to believe that there is now amongst us such a movement in this direction, emanating from diverse sources, that the time is not far distant when science will form as much a part of our own educational system as it does of that of other countries.

"Nature" appropriately opens with a series of aphorisms by Goethe; a semi-poetic composition, formed as it were, halfway between prose and poetry, in which an exalted form of prose almost merges into a regular rhythmus. Of Nature Goethe says:—"She tosses her creatures out of nothingness, and tells them not whence they came, nor whither they go. It is their business to run, she knows the

road. . . . . Her crown is love. Through love alone dare we come near her. She separates all existences, and all tend to intermingle. She has isolated all things in order that all may approach one another. . . She is complete but never finished. As she works now, so can she always work. Everyone sees her in his own fashion. She hides under a thousand names and phrases and is always the same."

The principal papers are "On the recent total eclipse of the Sun" by J. Norman Lockyer, and "On the fertilisation of Winter Flowering Plants" by A. W. Bennett. There is a review of Madsen's *Antiquités Préhistorique du Danemarck*, by Sir John Lubbock, and of Newman's "British Moths," by W. S. Dallas, and other shorter notices. A paper (read at the last meeting of the British Association for the Advancement of Science), by the Rev. W. Tuckwell "On Science-teaching in Schools" contains a number of very useful suggestions, and will be read by science masters with interest. Professor Williamson furnishes an interesting life of the late Professor Graham, and we wish we could commend the accompanying portrait to a like extent. Mr. Geikie gives an account of the meeting of German naturalists at Innsbruck. Among other features of the Journal we find several columns of "Notes," containing a chit-chat account of the matters most discussed in scientific circles at the present time. Finally, there is a *resumé* of recent work in all the more prominent branches of science, and of the proceedings of Societies and Academies. We wish "Nature" every success; it is well supervised, its contributors are manifold, and it is issued by an eminent firm of publishers. It will be a healthy sign of the times and of progress, when every educated man reads a scientific journal as regularly as he reads his "Saturday" or "Pall-mall," and to such a result the issue of "Nature" conduces.

Chemistry: General, Medical, and Pharmaceutical, including the Chemistry of the British Pharmacopœia. By John Attfield, Ph.D. London: John Van Voorst. 1869. 8vo; 624 pages.

The object of the author in compiling this work has been to combine a lecture-companion, reading-book, and practical class-guide in one. It is specially adapted to the wants of the medical and pharmaceutical student, and, with this intention, every substance which is employed in general practice as a remedial agent is chemically described. The work opens with advice to learners regarding the method of study; in which is detailed the requirements of various examining Boards, not, as might be supposed, suggestions as to the manner in which the study of chemistry should be begun, continued, and ended—supposing any ending of such a study were ever possible.

After a short introduction, a description is given of the non-metallic elements; and we can but think that a far too brief space has been allotted to these important bodies. There is, moreover, a want of definiteness which we regret to notice: take, for example, chlorine:—

"*Source.*—This element is a gas. Its chief source is common salt, more than half of which is chlorine. *Preparation.*—About ¼ of an ounce of salt, and the same amount of black oxide of manganese, are placed in a test-tube, with sufficient water to cover them. On adding a small quantity of sulphuric acid, the evolution of chlorine commences. . . During these manipulations, the operator will have noticed that chlorine is of a light green colour. . The distinctive property of chlorine is its bleaching power. . . . Chlorine readily decomposes noxious gases, and hence is one of the most powerful of *deodorisers*. Used in excess, it arrests and prevents putrefaction; hence is one of the best *disinfectants*. . . . After the gases (H and Cl) have mixed, the mouths of the tubes are quickly in succession brought near a flame, when explosion occurs, and fumes of hydrochloric gas are formed."

Now, we can imagine nothing more detrimental to the student than the singular want of exactness which is exhibited here at the very outset of the work. He will very naturally imagine that chlorine is a gas under all conditions known to us; that it is readily prepared without heat; that it possesses somewhat the colour of green peas, instead of, to our eyes, a dingy yellowish green, in which the yellow predominates over the green; that its chief property is its bleaching power; that it decomposes all noxious—that is, all unwholesome, or unhealthy, or hurtful—gases; and, finally, that hydrochloric acid gas is visible. We would particularly urge Mr. Attfield to attend more to details in the next edition of his work; for a chemical treatise which lacks accuracy is of little worth, specially to the student.

The "metallic radicals" are discussed at length and with some minuteness; the principal salts are described, and synthetical and analytical reactions are given, accompanied by a symbolic representation of the changes which occur. We are glad to notice that the derivation of words is introduced as frequently as possible, and though we cannot always agree with the roots which are given, it is undeniable that even an indication of the derivation of complex words often affords much assistance to the memory of the student. We would recommend to Mr. Attfield's notice, in connection with this subject, the "Essay on Metallick Words," of Sir John Pettus; the "Lexicon Etymologicon," of Gerard Vossius; and the useful little "Etymological Dictionary," of James Donald. The account of the metallic radicals is concluded by a useful "Analytical Chart for Metals," and by certain "Analytical Memoranda."

A detail account of the "Salts of Acidulous Radicles" is next given, then "Salts of Rarer Acidulous Radicles," their analytical detection, a very concise table of the solubility or insolubility of salts in water, and a chapter on "The Analysis of Salts."

About an eighth of the work is given to the following substances: — Alkaloids, Amylaceous and Saccharine Substances, Glucosides, Alcohol and Allied Bodies, Albumenoid and Gelatigenous Substances, Pepsine, Fatty Bodies, Resinoid Substances, Colouring Matters; and the following is an example of the mode of treatment:—

"*Strychnia or Strychnine.*—Formula, $C_{21}H_{22}N_2O_2$; molecular weight, 334. *Source.*—This alkaloid exists in nux vomica (*Strychnos nux vomica*), and in St. Ignatius Bean (*Strychnos Ignatius*), chiefly in combination with lactic acid. *Process.*—According to the official process for its preparation (*strychnos*, B. P.) the nuts, disintegrated by subjection to steam, and, after drying, grinding in a coffee mill, are exhausted with spirit, the latter removed by distillation, the extract dissolved in water, colouring and acid matters precipitated by acetate of lead, the filtered liquor evaporated to a small bulk, the strychnia precipitated by ammonia, the precipitate washed, dried, and exhausted with spirit, the spirit recovered by distillation, and the residual liquor set aside to crystallise. Crystalls of strychnia having formed, the mother liquor, which contains the brucia of the seeds, is poured away, and the crystals of strychnia washed with spirit (to remove any brucia) and re-crystallised." "Properties." "Reactions." "The Physiological Test," which we certainly think might be conducted in a more humane manner, although the frog is, as usual, the victim. And *apropos* of this, we all remember how the frogs once demanded of Jupiter a king, and what they got for it; now, considering how often frogs are sacrificed on the altar of science, we do think they have a right to demand something from Jupiter in recompense therefor. If there be any believers in metempsychosis in this age, let them think how terrible would be the second death of a relative whose soul had taken up its abode in a frog selected for Mr. Attfield's "Physiological Test." "A small frog" (there is a ray of humanity in the use of the word *small*, for the size might have been left to the discretion of the experimenter) "placed in an ounce of water, to which 1-100th of a grain of a salt (acetate) of strychnia is added, is, in two or three hours, seized with tetanic spasms on the slightest touch, and dies shortly afterwards."

The chapter on "Chemical Toxicology" appears to us to be precise and accurate, but far too short (seven pages) for so important a subject. The "Examination of Morbid Urine and Calculi" occupies eleven pages, and is accompanied by some very good plates of urinary deposits drawn by Mr. H. B. Brady, who is a careful microscopist.

The remainder of the work is devoted to "Quantitative Analysis," and occupies about one-sixth of the entire contents of the book. It is divided into the following sections:—Introductory remarks; Measurement of Temperature; Specific Gravity; Weights and Measures; Correction of the Volume of Gases for Pressure and Temperature; Volumetric Analysis; Gravimetric Analysis; Dialysis. We may specially notice a very detailed table (p. 459) for the quick conversion of thermometric degrees; a long list of specific gravities of "official liquids" and comprehensive tables of from five to seven decimal places of metrical measures and their corresponding English representatives.

Throughout the work we find at the end of each chapter a list of "Questions and Exercises," containing in all 1031 questions. These should be carefully worked out by the student, and will do much to impress facts upon his mind; it is needless to say that the only way in which they can be beneficial is if they are answered direct from memory, not after immediate reference to the book; thus a chapter should be read and if need be re-read, and a week or fortnight afterwards the questions appertaining to it should be answered.

The appendix commences with a long "Table of Official Tests for Impurities in Preparations of the British Pharmacopœia," arranged in the form of "Name of Preparation;" "Impurities;" "Test;" "Page." This will be found of the very greatest value to the pharmaceutical student, and should be so tried and tested that it is fixed in his memory. Then we have "Saturation Tables," and tables of the percentage of various acids and alkalies in solutions of various gravity, and finally a list of the apparatus and reagents required for the three months course of practical chemistry at the hospitals. We are glad to congratulate Mr. Attfield upon an unusually good index containing more than 5000 references, and extending over forty-four pages. To still further facilitate reference, three kinds of type are introduced into the index, a practice which might more often be followed with much advantage.

The work is not remarkable for any speciality of treatment or design; it bears no great stamp of originality upon it, but there is evidence of much hard work, and it is eminently comprehensive. Mr. Attfield has, however, attempted to put too much into a small space; that which is gained in variety of matter is too often lost in clearness of expression and in detail. He has laboured well at the work, and has introduced the most recent matter (such as the accounts of apomorphia and apocodeia) but what the work really wants is a careful, and by no means hurried, examination of each individual part, with a view to greater accuracy with equal conciseness; it is a grand mistake to attempt too much in books of this nature.

Now the motto and key-note of the work, which is to be found over against the preface, is taken from the "De Augmentis Scientiarum" of Francis Bacon, and is to the effect that some men seek for knowledge from curiosity and inquisitiveness, love of lucre, a livelihood, or reputation, and "but few for employing the Divine gift of reason to the use and benefit of mankind." If our author will look at the original passage, he will find the above a rather loose translation of the last phrase, for it is said "Paucissimi, ut donum ratione divinitus datum in usus humani generis impendant;" and if there were any other word expressing even a less number than "paucissimi" we fear it would have to be employed. If he be among those "paucissimi" he is indeed a happy man, and we envy him. And neglecting all the other reasons for which knowledge is coveted and communicated, who can say he is not among those of whom Bacon speaks as "alii existimationis gratia?" We candidly confess we cannot. No; if this work is to have a Baconian motto at all, we venture to imagine that this will be more appropriate:—"Homo Naturæ minister et interpres tantum facit et intelligit, quantum de Naturæ ordine, re vel mente observaverit; nec amplius scit aut potest."

The Sewage Question Settled by the Purification of Water, and the Manufacture, from Town Sewage, of a Dry and Portable Manure. London, 1869.

In this pamphlet we have an account of the works of the Native Guano Company, at Leamington. If the analyses which are given are reliable, the process certainly seems of much value. The organic matter is separated from the sewage by the addition of "a *solution* of animal charcoal, blood, clay, alum, magnesia, and other chemicals;" it is then allowed to settle, and, after drying in the air, it is ready for use as a manure. The supernatant fluid is colourless, and fish have lived for months in it. The deposit is in the form of a heavy black mud, about the consistency of treacle, and scentless. The following analysis shows the composition of the solid portions of the sewage, and of the fluid which remains after the addition of the compound which precipitates the organic matter (the bulk of liquid is not mentioned):—

	Organic Matter.	Mineral Matter.	Total.
Average of 50 samples of sewage	17·2	37·4	54·6
" " " effluent water	1·4	16·9	18·3

The town of Leamington has about 20,000 inhabitants, and yields nearly 600,000 gallons of sewage daily; from this about 5 tons per day of the dried manure is procured, inclusive of 10 cwts. of ingredients added as precipitants. The dry manure, as sold, possesses the following composition:—

Water	14·1
Organic matter	22·4
Phosphate of lime	9·6
Earthy and alkaline salts	11·2
Insoluble silicates	42·7
	100·0
Nitrogen = ammonia	4·2

The cost of manufacturing the manure is £1 10s. per ton, and it sells for £3 10s. per ton; and the total amount expended on the works has been less than £4000. It is very obvious that, until the precise nature of the substances added as precipitants is made known, together with detail and repeated analyses of the sewage, and of its precipitated products, it would be very unwise to do more than call attention to the scheme, the further application of which we shall await with some interest.

Outlines of Chemistry, or Brief Notes of Chemical Facts. By William Odling, M.B., F.R.S., Fullerian Professor of Chemistry at the Royal Institution. London: Longmans, Green, and Co. 1870. 8vo.; 468 pp.

This work consists of detail notes of the lectures which Dr. Odling has been in the habit of giving at St. Bartholomew's Hospital during the last seven years; of such notes, in fact, as are now frequently printed separately and distributed among an audience. It is much to be wished that this plan (which, if we remember rightly, was first introduced at the Royal Institution in 1862) was more often followed, as it must perforce give the listener a clearer idea of the lecture than he could otherwise have, while it prevents his attention from being diverted by the writing of notes. A lecture, after all, is chiefly for purposes of demonstration, and experiments are too often lost by the student who is desirous of making full notes; it is, moreover, always essential that numbers and complex formulæ should appear in other forms than as a momentary utterance or on the blackboard. This book is virtually a collection of lecture-notes; and the main object of the author was "to furnish the students of St. Bartholomew's with an abstract" of his lectures. Of necessity, such a collection of notes must form "*outlines* of

chemistry;" it is as a picture with all the broad details of design introduced, but without the filling-in and finishing. It is not intended to be used by itself, "but as a companion to the teachings of the lecture-room," and as an aid to the appreciation of more complete works, such as Miller's "Elements" and Watts's "Dictionary."

The work is divided into twelve chapters, the first whereof, although introductory, plunges into the middle of things, and treats of the law of volumes, equivalency, heat of combination, and so forth, and of some of the more complex questions of classification. Thus, in the section on "Acids and Salts," we find such paragraphs as the following:—"Mono-, tri-, and penta- equivalency of same perissad element as nitrogen, in different compounds as $\overset{v}{N}'_2O$, H_3N''', and $ClH_4\overset{v}{N}$? Di-, tetra-, and hexa- equivalency of same artiad element as sulphur, in Cl_2S'', $Cl_2S''''O$, and $S''''\overset{vi}{O}_2$, and $Cl_2\overset{vi}{S}O_2$, and $\overset{vi}{S}O_3$? Persistency of different equivalent values in double decomposition, as of stannous and stannic salts by lime—

$$Cl_2Sn'' + CaO = Cl_2Ca + Sn''O$$
$$Cl_4Sn'''' + 2CaO = 2Cl_2Ca + Sn''''O_2$$

Theoretical views concerning change of equivalency, real or apparent. Hypo- and hyper- saturated compounds, saturation by one another of two equivalencies of same atom (?)." Useful sections on the "Formula of Water," and on "The Heat of Combination," are found at the end of this chapter.

The second chapter treats of hydrogen and of the halogen elements, and the third of the oxygen elements. In the latter, the sulphur acids are discussed at some length, and the various actions of sulphuric acid on metals, oxides, and salts are illustrated very concisely by five reactions, in which, by the interchange of hydrogen for metal, we have sulphurous acid liberated when the strong acid acts upon metals; hydrogen when the weak acid acts upon more basylous metals; water or sulphydric acid when the acid acts upon oxides or sulphides; water and oxygen when it acts upon peroxides; and acids when it decomposes salts. This sort of classification of the action of one substance upon others of varied composition is of great use in fixing the separate qualities of a chemical substance in the mind of the student. In each case we have one constant and two variants, but each variant is the type of a class, and thus the changes become grouped within comparatively narrow limits. The system of types and of analogies is carried out to the fullest extent; on every possible occasion, related substances are compared; such we have in the list of the "oxides of hydrochloric acid, sulphuretted hydrogen, and phosphine" (p. 65). These expressions will appear strange to some of us, but Dr. Odling does not bind himself to any one name; thus H_3PO_4 is both an oxide of phosphine and ortho-phosphoric acid; $HClO_4$ is an oxide of hydrochloric acid and perchloric acid. In the above comparison, they are obviously called oxides of hydrochloric acid, sulphuretted hydrogen, and phosphine, because the compounds are similarly oxygenated, the HCl, H_2S, and H_3P being found in each compound of its respective series.

Chapter 5 treats of the carbon elements, and extends over nearly a hundred pages. To this group belong carbon, silicon, tin, and lead, a grouping which is founded on the tetrad character of these elements, as indicated by their combination with hydrogen, ethyl, fluorine, and chlorine. In the account of silicon, the terms *Silicomides* and *Siliconetted hydrogen* are employed. It is certainly surprising how such a word as "siliciuretted hydrogen" came to be introduced into chemistry, but it was undoubtedly made in agreement with such words as carburetted, sulphuretted, phosphuretted, &c. Nearly the whole of this chapter is devoted to carbon and mono-carbon compounds. These are divided into three groups; viz., the methylic typified by H_4C, the formic typified by formic aldehyde, H_2CO'', and the cyanic typified by hydrocyanic acid, HCN'''.

Chapter 6 gives a description of the Sodium Elements—sodium, lithium, silver, potassium, rubidium, cæsium. With these monad metals are considered the triad metals, thallium and gold, "on account of their each forming a series of monad compounds corresponding to those of potassium and silver." The group of magnesium elements consists of calcium, strontium, barium, beryllium, magnesium, zinc, cadmium, and mercury; and these are distinguished by replacing the hydrogen of hydrochloric acid in the proportion of one atom of the metal to two atoms of hydrogen.

The remaining chapters treat of the other groups of metals; to wit, the Tin Elements—aluminium, tin, didymium, thorium, and indium; the Arsenic Elements—titanium, zirconium, cerium, yttrium, erbium, lanthanum, arsenic, antimony, bismuth, vanadium, niobium, and tantalum; the Chromium Elements—chromium, molybdenum, and tungsten; the Iron Elements—manganese, iron, cobalt, nickel, copper, and uranium; and the Platinum Metals—palladium, platinum, rhodium, iridium, ruthenium, and osmium.

One of the most prominent features of this work, as of all Dr. Odling's works, is the constant attempt to classify—to collect together compounds which, however much they may differ in some respects, have at least one cardinal and prominent resemblance; and in such classifications he has wisely exercised his judgment in deciding which kind of resemblance shall determine the grouping of diverse bodies. This must ever be a matter of difference of opinion among chemists, although, for the good of the science, it is much to be wished that an universal mode of classification should obtain throughout the chemical world. The section on *Equivalency* in the first chapter treats specially of the modes of classification; the primary hydrides into mono-, di-, tri-, and tetra-hydrides; and so with chlorides, &c. Then the division of the elements into monads, diads, triads, and tetrads, and into artiads and perissads.

The derivation and explanation of terms, and the arguments in favour of the applicability of some in preference to others, is left to more detail works on chemistry; as, also, is any account of manipulation, and of the preparation of the various simple and compound substances described. This is by no means an elementary work. It is best fitted for the teacher and for advanced pupils; to those who are engaged in the delivery of long courses of lectures it will be invaluable. It is eminently methodical and systematic; if chemistry could ever be what Dr. Whewell calls "a classificatory science," Dr. Odling would be the man to make it so. The very nature of this work makes it *staccato* in character; and, since we have gone to music for a word, we may also say it is entirely free from *appogiature*. There is not a word too much; every sentence is sharp, precise, and to the point; it is a *précis* rather than a finished treatise. It reminds us of a map in which the principal cities and towns are introduced, while the villages are omitted. Compared with a detail "handbook" or "cours de chimie," it is as M. Logerot's "Souvenir du Nouveau Paris" compared with Fielding's map of that city.

Dr. Odling does not employ one form of phrascology; he appears, indeed, rather to prefer to vary the names of a substance as much as possible. He uses such names as cupric nitrate and zinc chloride "indifferently and alternatively" with nitrate of copper and chloride of zinc. The fact is, we are not to say of chemical compounds "by their names shall ye know them;" we must be so familiar with their nature and composition that we shall know them under any reasonable designation whatsoever. It is thus with friends; at first the name is the entity; while, on better acquaintance, the individuality of the entity manifests itself, and we know him and remember him for his character and qualities, the name in its first form of significance having of necessity vanished. It is thus, also, we suspect, that Dr. Odling wishes us to treat chemical compounds. Thus viewed, such terms

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as "oxide of hydrochloric acid," "nitro-marsh-gas," and "hydro-sodium-carbonate," grate less upon the ear than would otherwise be the case: it is familiarity with the compound designated which is to level the barrier of names. If our friend A. B. chooses to change his name to X. Y., he is the same to us, but to a possible future friend, Z., he virtually becomes another being, because Z knew him not before the change. Similarly, if we are familiar with the composition of the body HCN''', we may call it, "indifferently and alternatively," prussic acid, or hydrocyanic acid, or nitro-marsh-gas, or cyanic hydride; but, to the neophyte, the matter will appear in a very different light. "What's in a name?" Ask the gentleman who whilom bore the name of *Cimex Lectularius*, or that other one (whose name we also prefer to Latinise) who recently wrote to the *Times* complaining of the adverse influence of his name upon his daughter's matrimonial prospects; and no wonder, for he was called *Johannes Curtacola*. Modern chemistry does not allow her children to have fancies of this sort. In all seriousness, our science does contain a marvellous medley of names, derived from the most varied sources—Hebrew, Greek, Latin, Arabic, Spanish, Old High German, and Low Latin, combine to mystify and perplex the student.

Let us now justify our remarks as to the general character and the extreme conciseness of this work by giving one or two extracts taken at random.

"Methene, H_4C, obtainable from methyl alcohol, H_4CO, through intervention of methyl chloride, iodide, &c., by action thereupon of nascent hydrogen; from formic acid, H_2CO_2, by its transmission over ignited baryta; and from disulphide of carbon, CS_2, the sulpho-derivative of carbanhydride, by its joint reaction with sulphuretted hydrogen upon ignited metallic copper."

Again, in the account of the hydrocyanic and cyanic ethers, we find concise, comprehensive statements of the following nature:—

"β-cyanide of methyl unknown. β-cyanide of ethyl made by reaction of cyanide of silver and iodide of ethyl in sealed tubes—$IH_5C_2 + AgCN = AGI + H_5C_2CN$; also by action of chloroform on ethylamine, in presence of potash—$HCl_3C + H_2(H_5C_2)N = 3HCl + H_5C_2.CN$. Resistance of this cyanide to action of alkalies. Its immediate decomposition, with absorption of water, under the influence of acids, into formic acid and ethylamine—

$$H_5C_2.CN + 2H_2O = H_2CO_2 + H_2(H_5C_2)N."$$

Throughout, Dr. Odling has employed names which indicate the relationship of bodies to each other rather than their absolute composition. "For example," he says, "although I have no doubt whatever that corrosive sublimate is really a dichloride of mercury, there was a time when I was equally certain of its being a monochloride; and taught by this experience, I now prefer to distinguish it by the name 'mercuric chloride,' and calomel by the name 'mercurous chloride;' whereby I merely imply, what never has been a matter of question, that the ratio of chlorine to mercury is greater in the one compound than in the other." As a consequence of this method, it happens that bodies differently constituted have similarly constructed names; thus CuO. Fe_2O_3, and SnO_2, are cupric, ferric, and stannic oxides respectively. Dr. Odling has carefully avoided the use of any method of graphic notation: "It has," he remarks, "I believe, exerted, and still continues to exert, a most prejudicial influence on the study of chemical science, by making the fanciful sticking together of variously-pronged discs of more importance than the investigation of phenomena." Again, he has not expressed reactions molecularly, because, as he candidly remarks, "In the majority of reactions, I do not myself know what the molecular formulæ of the reagents and products concerned are, and do not think it worth while to make a pretence of knowing."

Now, we have been wont to regard Dr. Odling as the extremest radical in the world of chemists—indeed, as a sort of revolutionary red republican; and we rejoice to find him aking an intermediate course, leaving extreme views to the Raspails and Rocheforts of our science. There is no denying the fact that the science has progressed so rapidly of late that the prominent attitude of chemical thought is generalisation; facts have accumulated in such an astounding manner as the army of workers has increased that the desire of collecting particulars has, in many cases, been replaced by the desire of generalising upon the knowledge already attained. The temptation is, indeed, strong, but the science is not yet ripe for such a process. Certain chemists, seeing a little light in the distance, are hallooing before they are out of the wood. They may spare their voices yet awhile, and had better seek for the path which shall lead others from the gloom hereafter. We pray them to bear in mind Plato's exquisite parable of the dim cave, full of shadows which come and go; and to remember that there are two ways of investigating and discovering truth, to the first of which many have attached themselves. "*Altera a sensu et particularibus advolat ad axiomata maxime generalia atque ex iis principiis eorumque immota veritate judicat et invenit axiomata media. . . Altera a sensu et particularibus excitat axiomata*, ascendendo continenter et gradatim, *ut ultimo loco perveniatur ad maxime generalia; quæ via vera est, sed*" (too often, we fear) "*intentata.*" With a great din of shouting sounding in his ears, Dr. Odling has wisely preferred to reserve his own voice until he is fairly and fully clear of the wood, and we shall gladly trust ourselves to his guidance.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the past week, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Comptes Rendus des Séances de l'Académie des Sciences, October 25, 1869.

The following original papers and memoirs bearing upon chemistry and physical science are contained in this number:—

Remarks on the Communications made by MM. Vergnette, Lamotte, and Thenard.—M. Pasteur.—The author of this lengthy and criticising review condemns, in terms fortunately not frequently heard in the Mazarin Palace, the processes of the preservation of wine by heating it. The paper is too lengthy to admit of abstraction, and is, moreover, only of interest to wine-growing countries.

Fundamental Equations of the Mechanical Theory of Heat.—M. Reech.—A purely mathematical paper.

Illumination of Transparent Substances by means of Polarised Light.—M. Lallemand.—In order to see the illumination of any fluid, water, for instance, it is poured into a glass tube, which is closed at both ends by means of pieces of plate glass; the tube is then placed in a dark chamber in a horizontal position, and a ray of polarised light is made to shine upon the tube, which, when looked at sideways, will exhibit a vivid glimmering; but, seen in any other direction, the tube remains dark. Hence it follows that the propagation of the light takes place in the direction of the plane of polarisation; and it also follows that the vibrations of the waves of the ether take place in the perpendicular direction. When, instead of water, any other fluid is taken which is endowed with rotatory power—a solution of sugar, for instance—a very beautiful chromatic effect is displayed; the colours of the spectrum will be seen distributed in an elliptical shape. Cylinders of solid glass, submitted to the same experiment, exhibit somewhat similar phenomena, but less conspicuously than fluids.

Calorific Rays Emitted by the Moon.— M. Marié-Davy.—The author retracts his former negative statements on this subject, and now proves that, by another and differently-conducted set of experiments, he found that the moon emits calorific rays in abundance. The secretary read, also, a memoir on this subject, by M. Volpicelli, who, quoting the observations of more ancient and modern *savants*, comes to the conclusion, also, by his own observations, that the moon emits heat.

Bronzing of Copper.—M. Zalewski.—When objects made of copper are immersed in molten sulphur wherein lamp-black is kept suspended, the objects so treated obtain the appearance of bronze, and can be polished without losing that aspect.

Influence which Divers Luminous Rays Exert upon the Decomposition of Carbonic Acid and the Evaporation of Water from the Leaves of Plants.—M. Dehérain.—The author having extended his experiments on this subject, now states that all the luminous rays are not equally active in the decomposition of carbonic acid; that, even when the intensity is the same, the yellow and red rays act more favourably than the blue and violet rays; that the relation between decomposition and evaporation remains unaltered.

Preparation of Oxygen.—M. Delaurier.—The author states that, when manganate of lime is heated, oxygen is abundantly given off, and that by means of this salt it may be made very economically.

Metrical Weights and Measures.—M. Jacobi writes to the effect that the Royal Prussian Academy of Sciences is favourably disposed towards the proposal to establish an international committee for weights and measures.

Testamentary Disposition by M. Lacaze.—The perpetual secretary, M. Dumas, announces that the late M. Lacaze has bequeathed to the Academy a sum of 10,000 francs (£400), the interest of which is to be applied, bi-annually, to the distribution of prizes for chemistry, natural philosophy, and physiology.

The Journal of the Franklin Institute, September, 1869.

This number contains the following original papers and items:—

Gas Blasting.—While an excavation for a gas-holder tank was being made at Oswego, an old well had been pumped out and then filled up, after leaving an aperture beneath. Into this space a limited quantity of gas was introduced from the gas pipe, sufficient to form an explosive compound with the air in the covered well; this mixture being exploded by suitable means, caused a general upheaving of the surrounding earth, loosening the soil, and making digging easier.

Analysis of Hathorn Spring Water.—Dr. Chandler.—Grains to the gallon—Chloride of sodium, 509·968; chloride of potassium, 9·597; bromide of sodium, 1·534; iodide of sodium, 0·198; fluoride of calcium, a trace; bicarbonate of lithia, 11·447; bicarbonate of soda, 4·288; bicarbonate of magnesia, 176·463; bicarbonate of lime, 170·646; bicarbonate of strontia, a trace; bicarbonate of lime, 1·737; bicarbonate of iron, 1·128; phosphate of soda, 0·006; biborate of soda, a trace; alumina, 0·131; silica, 1·200; organic matter, a trace; total solid constituents, 888·403 grains; carbonic acid gas in one gallon, 375·747 cubic inches; specific gravity, 1·009.

Various Processes for Preserving Timber.—Dr. Ott.—From this paper, which is to be continued, we learn that the first attempts in this direction were made by the German chemist Glauber, and consisted in first charring the surface of the timber, then coating it with Stockholm tar, and immersing it in crude acetic or more properly pyroligneous acid. The author then reviews at length the various methods applied for the preservation of timber, treating of injection with brine, or salting timber, which is not of much use unless, indeed, the salt could be made to penetrate through the very heart. Speaking of Mr. Beer's process, that is to say, the treatment of wood in a boiling solution of borax in water, the author observes that beside the ready solubility of borax in water (one part in twelve of cold water), borax, like all alkaline salts, has the property of dissolving, or at least attacking, the so-called incrustating matter of the wood, upon which its strength, solidity, and toughness greatly depend; moreover, borax also dissolves the resin which is therefore eliminated from the wood, and in regard to its (borax) claimed superiority in withdrawing the putrefiable substances, it may be stated that not less than 14 per cent of the original amount of albumen have been retained in saw-dust, after boiling it several times, and each time for hours with a saturated solution of borax.

Cosmos, October 23, 1869.

Extracts from Vegetables.—M. Berjot.—This gentleman has applied to the vegetables in ordinary use for culinary and domestic purposes the process long since very successfully carried out for vegetables to be used in pharmacy, viz., of expressing by strong hydraulic pressure the juices of such vegetables, and concentrating the same by evaporation *in vacuo*, and preparing extracts thereof suitable for making soups and sauces, 1 gramme of these extracts being sufficient to convert 1 litre of bouillon into a good soup.

Porte-plume-enerier Velocigraphe.—Dr. Poznanski.—Under this title is described at great length, accompanied by a woodcut, an instrument which, if what is stated about it is correct, will, in a very short time, be greatly in demand by all who have much writing to do. The instrument is a combination of pen-holder, pen, and ink reservoir, and the ink flows into the pen by means of a self-acting valve and piston, as long as the writer requires it; we cannot give more details without re-producing the cut.

Estimation of Urea.—Dr. Byasson.—Take 50 c.c of the urine to be tested from the urine in a flask, and next add 25 c.c. of baryta water, and shake the mixture, filter off the precipitate, the filtrate from which should be alkaline; take 10 or 20 c.c. of this filtrate, and pour it in a vessel suitable for precipitation, and place the vessel on a sheet of white paper; then add from a graduated burette a mercurial solution (made by dissolving 36 grammes of red oxide of mercury in 5 grammes of nitric acid diluted with as much water; this dissolution is aided by heat and carried on until, by evaporation, red fumes are beginning to be given off, when the saline mass is dissolved in 1 litre of distilled water), keeping the fluid well stirred. From time to time small quantities of a solution of caustic potassa of 25 grammes to the litre are added; by this proceeding a yellow precipitate is formed. This first assay is only approximative, and should be followed by at least two other similar operations. Every c.c. of the mercurial liquid applied represents 0·005 gramme of urea; the mercurial solution is controlled by means of a urea solution made by dissolving 20 grammes of crystallised urea in 1 litre of distilled water.

Zeitschrift für Chemie von Beilstein, No. 19, 1869.

This number contains the following original papers:—

New Method for the Synthetical Preparation of Salicylic Acid and its Homologues.—M. Vogt.—The author says—Some few months ago, M. Oppenheim and I proved that chloride of phenyl is not readily acted upon by fusing caustic potassa, unless that chloride is converted into the corresponding sulpho-acid. While the writer was engaged in experiments with chlorinated toluol and xylol, expecting to obtain orcine and β orcine, the result was the formation of salicylic and cresotinic acid. Chlorinated toluol was mixed with fuming sulphuric acid, and afterwards sub-

mitted to heat; as soon as the chlorinated compound was dissolved, the mixture was diluted with water, and baryta solution was added, until a precipitate ceased to appear. The liquid was next filtered, and neutralized with a solution of carbonate of potassa; in this manner a salt, $C_7H_6ClSO_3K$, was obtained in pearly plates. This compound was fused with caustic potassa, and, after a lengthy purifying treatment, first with water, next hydrochloric acid in excess, then ether, and again saturation with carbonate of potassa, and decomposition, again, of the saline mass by excess of an acid, salicylic acid was obtained, in small quantity, but sufficient to test its most prominent features. Bromated toluol, treated in the same manner, yields the same result. Chlorinated xylol, submitted to the same treatment, yields cresotinic acid, a solid substance which crystallises in elongated prisms, fuses at 148°, difficultly soluble in water, and yields, with chloride of iron, a violet tinge.

Action of Deutoxide of Nitrogen upon Terpen.—M. Bunge.—The author says—Some thirty years ago, M. Cahours published a paper wherein it was stated that deutoxide of nitrogen combines with the terpen of essential oil of feuchel, yielding a substance, $C_{15}H_{24}(NO)_4$, which, consequently, is a nitroso hydrocarbon. These researches of the last-named author have been repeated by the author of this paper, with the following results:—(1) Pure deutoxide of nitrogen does not combine with the terpen of essential oil of feuchel, and is hardly even absorbed by it; (2) when the deutoxide of nitrogen is brought into contact with the aforesaid terpen, air being at the same time admitted, the compound described by Cahours is formed; (3) pure hyponitric acid, prepared from nitrate of lead free from chlorine, is plentifully absorbed by the terpen alluded to, but the result is not the formation of a crystalline substance; (4) when the terpen is mixed with an aqueous solution of nitrite of potassa, to which some acetic acid is added, the terpen is thereby converted into a crystalline mass, which, although identical with that described by M. Cahours, differs from it in composition, its formula being $C_{10}H_{16}(N_2O_3)$. Ordinary oil of turpentine (purified, of course), and the terpen from Copaiva balsam, do not yield, when treated as described, crystalline compounds. When the nitrate of lead, employed for the evolution of hyponitric acid, contains chlorine, or if, purposely, chloride of lead is added to the nitrate, and the gas thus obtained be passed through the terpen of essential of feuchel, this fluid soon becomes turbid, and the result is the formation of a substance insoluble in water and hardly soluble in either absolute alcohol or ether; this compound is expressed by the formula $C_{10}H_{14}NO_2Cl$. The terpen of Copaiva balsam yields an analogous compound.

Formation of Green Sulphide of Manganese by the Wet Way.—M. Muck.—When the salmon-coloured sulphide of manganese is submitted to heat while yet in moist state, it becomes green. The author distinctly states that the green sulphide alluded to is not identical with that obtained by the dry way. After quoting several observations of the same phenomenon recorded by other scientific men, the author says—The salmon-coloured sulphide of manganese, when seen under the microscope with a magnifying power of from 200 to 300 diameters, is observed to be a completely amorphous substance; the green sulphide, however, exhibits, under the same conditions, greenish coloured transparent quadratic tables. The preparations of manganese applied for the purposes of experiments, are perfectly pure, and quite free from any other metals precipitable by hydrosulphuret of ammonium. The results of a series of researches on this subject are, that, when an excess of hydrosulphuret of ammonium is applied as precipitant:—1. Very dilute and cold solutions of the chloride and sulphate of manganese yield a salmon-coloured MnS, which, even when kept for several weeks, does not exhibit the least tendency to become green coloured. 2. The same solutions, when precipitated while hot, yield flocculent precipitates, which are bright green-coloured; the solution of the sulphate yields a precipitate akin in colour to the hydrated oxide of chromium. 3. When the same solutions are quite concentrated, the precipitates formed are, at first, salmon-coloured; but, after a short time, and even without the application of heat, the precipitates, while shrinking enormously, and becoming pulverulent, get green-coloured. When a large proportion of a solution of chloride of ammonium was added to the solutions of the salts of manganese just alluded to, previous to adding the precipitant, a nearly blackish green, very dense MnS was thrown down. The following salts of manganese, in solid state, behave towards hydrosulphuret of ammonium in the manner thereby respectively expressed:—The chloride is rapidly converted into a green sulphide, even at the ordinary temperature of the air; the sulphate is more slowly acted upon, but the result is the same; the nitrate, solid as well as solution, is only partly converted into a green sulphide; the phosphate and oxalate yield, rapidly, a green sulphide; the carbonate never yields a green sulphide, but always the salmon-coloured. A concentrated solution of the chloride of manganese yields, on being precipitated by the hydrosulphuret of ammonium only, then, a green sulphide of manganese when the precipitant is in excess and all the metal thrown down; the green sulphide yielded, on careful analysis, by means of drying in a current of dry sulphuretted hydrogen gas, 7·43 per cent of water. When, instead of hydrosulphuret of ammonium, the various soluble sulphides of potassium or sodium are applied as precipitants, the author never obtained a green sulphide of manganese under any conditions.

Conditions under which the Sulpho-Carbanilide and some Analogous Substances are Decomposed.—MM. Merz and Weith.—The subject treated of in this lengthy essay may be summarised in the following manner: The authors proved that nascent hydrogen has the effect of desulphurising sulpho-carbanilides; but, instead of obtaining, as they expected, methylendianiline, other products appeared. This phenomenon they attributed to the presence of acid, and, therefore, they repeated experiments formerly made, and applied perfectly neutral solutions; but this precaution, notwithstanding the sulpho-carbanilide, was decomposed as before. The paper contains, further, a lengthy description of the origin and products of decomposition of a number of complex organic substances, as, for instance, triphenyl-guanidine, sulpho-carbanilamide, tricarbo-hexanilide, and others.

Action of Permanganate of Potassa upon Quinine.—Dr. Kerner.—One part of pure quinine is dissolved in excess of pure nitric or hydrochloric acid; the solution is heated to about 50° or 60°, and there is added to it a concentrated solution of two parts of permanganate of potassa in water at the same temperature, and the liquid well stirred and heated some 15° or 20° higher. The fluid is separated by filtration, from the precipitate of peroxide of manganese, and next evaporated to about one eighth of the original bulk. The liquid, which should exhibit an alkaline reaction, is next acidified, upon which the new substance, dihydroxyl of quinine, is precipitated; this material will require to be purified from colouring matter by means of a very dilute solution of soda. The purified substance, after having been re-crystallised from its aqueous solution, exhibits a crystalline material, difficultly soluble in cold water and alcohol, and more readily so in these fluids when hot. Its composition is represented by $C_{20}H_{26}N_2O_4$; its formation from quinine may be represented by—

$$C_{20}H_{24}N_2O_2 + H_2O + O = C_{20}H_{26}N_2O_4.$$

On Oxytoliden.—MM. Limpricht and Schwanert.—When an ethereal solution of toluylen is treated with bromine, there is formed, besides bromated compounds, a substance, $C_{14}H_{10}O_2$, which the authors call oxytoliden, in pure state exhibiting a solid crystalline substance, fusing at 172°, subliming at a higher temperature, without decomposition, soluble in ether and alcohol, not acted upon by an alcoholic solution of potassa, neither by reducing agents. The authors obtained, by means of the action of chlorides of phosphorus

upon this oxytoliden, chloroxytoliden, $C_{14}H_9ClO_2$, a solid substance, fusing at 57°, and soluble in alcohol; trichloroxytoliden, $C_{14}H_7Cl_3O_2$, also a solid substance, fusing at 87°, and readily soluble in warm alcohol; pentachloroxytoliden, $C_{14}H_5Cl_5O_2$, a solid matter, fusing at about 190°, and difficultly soluble in hot alcohol. The structure of oxytoliden is represented by—

$$C_6H_4—O—CH$$
$$\quad\quad\quad\quad\quad|$$
$$C_6H_4—O—CH$$

On Thionessal, Tolallylsulphide, Lepiden, and Oxylepiden.—Dr. Dorn.—Thionessal, $C_{28}H_{20}S$, is not readily desulphurised, even by being heated to a feeble red heat along with either iron or copper filings. The heating of thionessal with chloride of phosphorus also fails to effect desulphuration; but there is formed a bichloride of thionessal, $C_{28}H_{18}Cl_2S$, a solid substance, fusing at 219°. Tolallylsulphide resists the action of red-hot copper; but, on being treated with chlorate of potassa and hydrochloric acid, it is readily converted into oxylepiden, and therefore the formula of tolallylsulphide ought to be $C_{28}H_{20}S$. Oxylepiden, $C_{28}H_{20}O_2$, when acted upon by reducing agents, is converted into lepiden, $C_{28}H_{20}O$, which does not, however, give up any more of its oxygen to any reducing agents; and when it is treated with chloride of phosphorus, yields a series of products of substitution, containing chlorine—viz., bichloroxylepiden, $C_{28}H_{18}Cl_2O_2$; bichlorlepiden, $C_{28}H_{18}Cl_2O$; pentachlorlepiden, $C_{28}H_{15}Cl_5O$; hexachlorlepiden, $C_{28}H_{14}Cl_6O$; and octochlorlepiden, $C_{28}H_{12}Cl_8O$. All of these are solid substances.

The Pyromucic Acid Group.—M. Limpricht.—The combinations of this group can, according to this author, be deduced from a hydrocarbon—

$$HC=CH$$
$$\quad|\quad|$$
$$HC=CH$$

In order to prove this statement, a series of experiments have been made, which are recorded in this paper. Pyromucic acid in aqueous solution is decomposed by bromine, with evolution of carbonic acid, according to the following formula:—

$$C_5H_4O_3+H_2O+Br_2=C_4H_4O_2+CO_2+2HBr.$$

There are simultaneously formed a bromo substitute, an oily substance, and, under conditions which are not precisely defined, a compound, $C_4H_3BrO_2$, a solid, insoluble in water, alcohol, and ether, and fusing at 84°. Among the products of the complete decomposition of an aqueous solution of pyromucic acid, fumaric acid, $C_4H_4O_4$, occurs; and this acid, treated with sodium amalgam at 180°, yields succinic acid.

Arsenic in the Soda of Commerce.—Dr. Fresenius calls attention to a fact accidentally discovered by him, that the carbonate of soda (neutral), as met with in crystallised state, and as manufactured at the alkali works, now often contains a very perceptible quantity of arseniate, or arsenite of soda, undoubtedly due to the use of sulphuric acid for converting the common salt into sulphate of soda, which acid contains arsenic, derived from the pyrites of which few are quite free from arsenic, and some of which contain that substance in considerable quantity. The tests applied for the detection of this arsenic were not the most delicate in use for this purpose; and the quantity found, though small, is sufficient to affect the purity of preparations for medicinal and chemical use.

Les Mondes, October 28, 1869.

From this number we abstract the following original communications and papers:—

Electrical Explorator.—M. Trouvé.—Although this subject does not exactly bear upon chemical science, we may call attention here to what is stated in the original. The explorator alluded to is a small instrument destined to detect, by means of electricity (galvanic current), any metallic or other objects, but especially rifle-balls and pieces of shot and shell, which may have penetrated the body or limbs of men and animals. At an Exhibition, recently held at the Hague, of objects relating to army surgery, and the necessary means of taking care of the wounded in battles, Dr. Winkhuijsen, physician to His Majesty the King of the Netherlands, ingeniously introduced, in limbs made of plaster of Paris, different projectiles of iron and lead, and was thus enabled to exhibit the action of this very useful instrument, by the aid of which, even though no open wounds exist, the presence of such projectiles may be readily detected with certainty, and the extraction proceeded with. Not only metallic, but also stone and wooden objects, which might have penetrated, can be detected.

On Combustion.—M. A. Boilot.—The author's chief conclusion on this subject is, that the distinction between supporters of combustion and combustibles is a pure fiction; there are neither combustibles, nor supporters of combustion, nor, also, any inert substances. In all reactions, each substance brings with it a portion of caloric, and absorbs a certain quantity thereof. Incandescence and heat are, in many cases, principally, if not solely, due to oxygen, but equally so to other bodies under other conditions. Oxygen is not only a supporter of combustion, but it is as much a combustible as the substances which burn in it.

Galvanic Tinning.—M. Maistrasse-Dupré.—The author, it appears, has been commissioned by the French government to apply, by galvanic means, tin upon divers objects which had been made of so-called galvanised iron—that is, iron covered with zinc. To this purpose he applied galvanic elements made of copper and zinc plates, the length of which is 1·20 metres, the width 0·70 metre, placed in a leaden trough and separated and isolated by means of wooden partitions. The copper sheet was immersed in a mixture of equal parts of acetate of lead and common salt, and the zinc element was placed in weak sulphuric acid, sp. gr. 1·060. This battery remains in constant action and working order for eight days, at an outlay of only 2 francs. When the objects which are galvanically tinned are afterwards heated to the melting-point of tin, the goodness and durability of hot-tinned materials is thus obtained. Copper thus tinned (galvanically), and afterwards heated, is superficially converted into bell-metal, while the method of tinning galvanically has the great advantage over the old method, that it can be applied to objects to which the method of tinning in ordinary use is not applicable.

Automatic Steam-Boiler Feeding Apparatus with Constant Level.—M. Macabies.—In a few words we call attention to an excellent piece of useful apparatus, not a toy or complicated mechanism requiring highly-skilled labour for superintendence. It is placed on the boiler, and, as soon as steam is up, begins its work, and acts uninterruptedly, pumping, or rather sucking, either cold or boiling water, even from great depths, and forcing it regularly into the boiler. There are no parts in the apparatus liable to get out of order; and, though its construction and mode of action could not be well understood without woodcuts, its main principle and action is that of the well-known Monte-Jus.

New Source of Quicksilver.—A layer of quicksilver ore has been recently discovered in the district of Sarawak, Borneo, which ore promises to be one of the richest in the world. A trial of a large quantity of this ore has been made, and proved to yield from 70 to 80 per cent of metal; this ore is, therefore, very nearly pure sulphide of mercury, and is of very rare occurrence, since the average of mercury ores yet known do not contain more than from 2 to 20 per cent of metal. Borneo is rich in minerals of all sorts, and the ores found there are of exceedingly good quality.

Researches on Tobacco.—M. Schlœsing.—Most of our readers will be aware that the sale of tobacco is a monopoly of the French Government; but it is not so generally known that, at the very extensive central manu-

factory at Paris, there is established a very well-arranged chemical laboratory, where researches are being continually conducted with tobacco, in its various stages of preparation, as well as in its green, or, rather, raw-dried state. There are very few substances produced, either by the vital functions of plants or animals, which contain so large a variety of different chemical compounds as tobacco does. The inorganic substances it contains are:—Potassa, lime, magnesia, oxides of iron and manganese, ammonia, nitric, sulphuric, hydrochloric, and phosphoric acids, and silica. The organic substances are:—Nicotine, $C_{10}H_7N$; malic, citric, acetic, oxalic, pectinic, and ulmic acids; nicotianine; a green and yellow resin; wax and fat; albumenoid substances; and cellulose. Nicotianine, also known as tobacco camphor, is a fatty substance, exhibiting the pleasant aromatic odour of tobacco-smoke, and having an aromatic bitter taste. Nicotianine is probably identical with coumarine. Nicotine is an organic base; it is, in the pure state, a colourless, oily liquid, of very acrid taste; soluble in water, alcohol, ether, and oil; and a most dangerous poison. According to the author, the quantity of this substance contained in 100 parts, by weight, of dry unmanufactured tobacco-leaves, ripped from the stems, varies considerably, even for tobacco cultivated in France, from 7·96 to 3·24 per cent; for American tobacco, the quantity varies from 6·87 to 2·29 per cent; while the so-called Habana (properly Cuba) tobacco contains only 2·0 per cent of this alkaloid. Snuff, which contains on an average 33 per cent of water, contains 1·36 per cent of nicotine. The quantity of ash contained in tobacco in dry state varies from 19 to 27 per cent. 100 parts of the ash contain:—Potassa, 29·96; soda, 2·76; lime, 39·53; magnesia, 9·61; chloride of sodium, 9·65; sulphuric acid, 2·78; silica, 4·51; phosphate of peroxide of iron, 4·20. The more or less easy combustibility of tobacco does not depend upon the quantity of nitre it contains, since experiments made by the author have proved that the Kentucky tobacco, which contains a large quantity of saltpetre, burns badly, while Java, Maryland, and Hungarian tobacco, which contain hardly any saltpetre at all, burn very well. The author found that tobacco which burns badly, or not at all (at least, not so as to be suitable for the use of smokers), burns very well after having been steeped for some time in an aqueous solution of an organic potassa salt (oxalate, malate, citrate, or tartrate answer the purpose), and next dried. A well-burning tobacco becomes badly-burning, or even non-combustible, by being steeped in aqueous solutions of sulphate of lime, chloride of calcium, magnesia, or ammonia. The rationale thereof lies in the fact that the organic salts of potassa just alluded to yield, on combustion, a very bulky, porous, and light coal, which burns off readily on access of air. This paper contains some very important facts relating to the preparation of tobacco and snuff, obtained on a very large scale, working with some hundreds of thousands of tons annually.

Polytechnisches Journal von Dingler, second number for September, 1869.

This number contains the following original papers relating to chemistry:—

Construction of Sulphate Furnaces (Sulfatoefen).—M. Lunge.—This paper is an excellent contribution to the technology of the manufacture of soda by M. Leblanc's process; but the paper is not well suited for abstraction, since there are added to it several engravings absolutely required for the proper understanding of the subject.

Manufacture of Sulphate of Alumina.—M. Pemberton.—Hydrate of alumina is mixed with sulphuric acid and water in the requisite proportions for the formation of neutral sulphate of alumina, $Al_2O_3,3SO_3+18HO$; the best proportions are 150 kilos. of moist hydrated alumina containing 38 per cent of that hydrate, and 200 kilos. of sulphuric acid at 58 Beaumé (sp. gr. 1·678). These quantities yield from 325 to 340 kilos. of neutral sulphate of alumina, which crystallises readily. It should be borne in mind that no larger quantities than those just named should be operated with at one and the same time, because the chemical action which sets in is very violent, and if the heat thereby evolved becomes too great, the operation is spoiled.

Preparation of Indium in Pure State.—MM. Röszler and Wolf.—The authors make use of the Freiberg zinc for the purpose of obtaining indium. The zinc is dissolved in hydrochloric acid, and next boiled with excess of metallic zinc, whereby a spongy metallic precipitate is obtained of the following composition:—Lead, 1·36; tin, 0·02; cadmium, 0·13; copper, 0·004; indium, 0·015; together, 1·529 per cent of the metallic zinc employed. This mass is first treated with sulphuric acid to remove the lead. The whitish-coloured mass is next treated with boiling water; this solution is again treated with zinc, whereby a spongy metallic mass is obtained, which is acted upon by strong nitric acid, the excess of which is evaporated, and the oxides of tin and any remaining sulphate of lead are eliminated. The residue is taken up with water, to which ammonia is added, whereby the oxide of indium is precipitated; and, after drying, this oxide is reduced to the metallic state by means of cyanide of potassium.

Artificial Preparation of Anthracen.—Dr. Greiff.—The author prefers the preparation of anthracen from asphalte or pitch, instead of coal-tar, since the purification of the product is more readily effected when it is obtained from solid substances, by sublimation, in a manner somewhat similar to the manufacture of carbonate of ammonia. Too much and too long heating should be avoided. The quantities of anthracen yielded by tar, as well as by asphalte, vary greatly, and the cause thereof is not at present well ascertained.

Keeping Water in Tanks made of Zinc.—M. Ziurek.—The author calls attention to the fact that water kept in zinc vessels (reservoirs), or, also, collected from roofs covered with that metal, is invariably contaminated with that metal, and that the use of such water, either for domestic or industrial purposes, is highly injurious to health. The author recommends that, where zinc vessels are used for the purpose indicated, they should be painted over with asphalte varnish or any iron pigment.

Journal de Pharmacie et de Chimie, October, 1869.

This number contain the following original papers:—

Chlorides of Acetylen and Synthesis of the Chloride of Julin.—MM. Berthelot and Jungfleisch.—The authors have made perchloride of antimony act upon acetylen, which is very readily absorbed by this chloride with evolution of great heat, in consequence whereof it becomes necessary to moderate the action so as just to keep the mixture in fluid state. On cooling, magnificent large crystalline lamellæ are deposited, which are a compound of acetylen and perchloride of antimony, $C_4H_2SbCl_5$. This compound is very unstable; it is immediately decomposed by water, and on the application of heat it is converted into perchloride of acetylen and protochloride of antimony, $C_4H_2.SbCl_5=C_4H_2Cl_2+SbCl_5$. Protochloride of acetylen, $C_4H_2Cl_2$, is a clear, colourless, very mobile liquid, exhibiting, in a high degree, the smell of chloroform; its taste is somewhat sweet, and its vapour causes headache; it boils at 55°; water, as well as moist air, decomposes it slowly; and if heated, along with water, up to 180°, it is decomposed into hydrochloric acid and some volatile products. Heated to 360° in a sealed tube, it is entirely decomposed into a black carbonaceous mass and hydrochloric acid, without

giving rise to any secondary products. Perchloride of acetylen, $C_4H_2Cl_4$, is a colourless fluid, exhibiting the smell and taste of chloroform; it boils at 147°; heated to 180°, along with water, it is slowly decomposed; brought into contact with chlorine gas, it is converted into sesquichloride of carbon. By cautiously treating this compound with an alcoholic solution of caustic potassa, hydrochloric acid is withdrawn, and protochloride of acetylen formed. Heated to 300°, for at least twenty-four hours, in a sealed tube, the chloride of julin is formed, which is obtained even better by allowing the heat to act up to 360° for 100 hours consecutively. The chloride of julin is identical with perchloride of benzine.

Boiling and Melting Points.—M. Fleury.—The determination of temperatures requires a correction for that portion of the column of mercury of the thermometer which is not itself immersed in the hot medium. This correction is very liable to error, which may amount to even 10° or 15°. The author proposes the use of a metastatic thermometer.

Researches on the Bleaching of Tissues.—M. Kolb.—This paper contains the first instalment of a lengthy series of researches on this subject, but it is not well suited for abstraction.

Milk at Marseilles, and Milk in General.—M. Commaille.

Reagent for Copper and Iron.—M. Bellamy.—The alcoholic tincture of Campeachy wood, sometimes applied for the detection of bicarbonate of lime in potable waters, is, according to the author, a most valuable test for the detection of very minute quantities of iron or copper present in water. Both metals turn the colour of this tincture, when added to water containing minute quantities of the same, to a peculiar blue colour. According to the researches made on this subject, 1 grm. of iron, present in 20 cubic metres of water (rather more than 20 tons in weight), has the effect of being perfectly detectable by this tincture—that is, 1 part of metal in 20,000,000 parts of water; but after the water has been boiled, no reaction is observed. The metals are chiefly found in natural potable waters as carbonates.

Analysis of the Spring Water from Santa Catalina and Guadalupe (Canary Islands).—M. Méhu.—This spring, although only situated at 85 metres from the seaboard, does not exhibit any sign of being connected with the sea. The water of the spring is very clear, its taste saline, and the yield abundant; it reddens litmus paper; temperature, 26·66°. The dry residue from 1 kilo. of water, evaporated, and the residue dried at 180°, weighs 8·47 grms. The composition of the solid residue, expressed in grm. weight, is:—Chloride of sodium, 6·0921; chloride of potassium, 0·1080; chloride of calcium, 0·2833; bicarbonate of lime, 0·1482; bicarbonate of magnesia, 1·1654; sulphate of magnesia, 0·8766; silica, 0·1084; free carbonic acid, 1·0112. The weight of the anhydrous salts contained in 1 litre of this water amounts to 8·7828 grms. Guadalupe Spring (*Gran Canaria*).—This spring is situated at a height of 210 metres above sea level, at a distance of 4 kilometres from the sea shore, and at 10 kilometres from the Santa Catalina spring. The temperature of the water of this spring is 29°, and it yields 514 litres of water per hour. The composition of the residue, after evaporation of 1 kilo. of the liquid, and drying at 180°, expressed in grm. weight, is:—Chloride of sodium, 0·11606; bicarbonate of soda, 0·79673; bicarbonate of potassa, 0·01978; bicarbonate of lime, 0·42251; bicarbonate of magnesia, 0·26473; sulphate of magnesia, 0·10700; silica, 0·11850; free carbonic acid, 1·05790. Weight of anhydrous salts to the kilo. of water, 1·845 grms.

Preparation of Nitrogen.—M. Levy.—When bichromate of ammonia is heated in a retort, that salt is converted into green sesquioxide of chromium, vapour of water, and pure nitrogen.

Revue Hebdomadaire de Chimie, October 28, 1869.

This number contains the following original papers and communications:—

Proper Mode of Sampling and Preserving the Samples of Raw Sugar for Quantitative Analysis.—M. Weinzierl.—The author calls attention to the discrepancies of the results of the analysis of raw sugars taken from the same large parcel, and submitted to investigation by different analytical chemists, in order to prove, by incontrovertible evidence, that, even when the samples are carefully taken (it is generally done by experienced brokers, who, being provided with proper tools, have thereby the means of taking from every box, cask, bag, kranjang, or basket, as the case may be, a fair sample representing the entire quantity contained in such parcel), the mode of keeping and preserving these samples may seriously interfere with the results of the analysis. For this purpose, the author has compared samples of raw sugar, kept in pasteboard boxes for 24, 48, 72, and 96 hours respectively—(1) kept in similar boxes inside lined with tin-foil; (2) kept in pasteboard boxes which were four times varnished with shellac varnish; (3) pasteboard boxes painted over with the paint ordinarily used for painting sheet iron sugar-loaf forms; (4) samples kept in tinned-iron boxes; and lastly, samples kept in glass-stoppered bottles. The result of analysis of samples thus kept for 96 hours was as follows (the original sample, immediately on being taken, gave, in 100 parts—sugar, 91·70; water, 3·54; impurities, 4·76):—Sample-box 1, in 100 parts—Sugar, 92·90; water, 2·28; impurities, 4·86. Sample box 2—Sugar, 91·90; water, 3·30; impurities, 4·80. Sample-box 3—Sugar, 92·40; water, 2·88; impurities, 4·72. Sample-box 4—Sugar, 91·90; water, 3·31; impurities, 4·79. Sample kept in tinned-iron box—Sugar, 91·80; water, 3·50; impurities, 4·70. Sugar kept in glass-stoppered bottle—Sugar, 91·70; water, 3·52; impurities, 4·78.

Reagent to Detect the Presence of Resin of Guaiacum among Resin of Jalappa.—M. Blacher.—When 50 centigrms. of pure and pulverised resin of guaiacum are mixed in a porcelain mortar with 20 centigrms. of black oxide of copper and about twenty drops of alcohol (not methylated spirits), nothing noteworthy is exhibited; but if to this mixture some fifteen drops of liquid ammonia are added, and trituration continued, there will be seen, within a minute, a beautiful apple-green colour. If this experiment is repeated with the same quantities of material, but pure resin of jalappa taken instead of the resin of guaiacum, the original brown colour of the latter remains predominant, and no greenish or bronzy colouration ensues. The quantities mentioned are not absolute, but the author thinks it best not to depart, in either more or less, from the same. There is formed a *guaiacinate ammoniaco-cuprique* (ammoniacal cuproguaiacinate).

Nutritive Value of Divers Roots used as Cattle Food and for Sugar Manufacture.—M. Corenwinder.—The author has estimated the quantity of nitrogen contained in the following roots, and found that to amount, percentically:—In yellow beet-roots, 1·087; sugar beet-root, 1·044; rutabaga, 1·41; pulp of sugar beet-root, expressed by Champonnois process, 1·36. What rutabaga is, is not explained. Although not an absolute criterion, the quantity of nitrogen contained in vegetables of this kind expresses fairly their average value as food, taking the other constituents into consideration.

Method for Staining Naturally White-Coloured Woo —M. Mène.—When naturally white-coloured woods are painted over with a concentrated aqueous solution of permanganate of potassa, which is best kept somewhat warm (tepid), it is possible thereby to give such woods the appearance of palissander or walnut wood. Different kinds of wood behave with this solution in different manner; the wood of pear and cherry trees is rapidly stained; white woods, as, for instance, the acacia (*Rubinia pseudo-acacia*), resists a longer time; and resinous woods, like fir, are more difficultly acted on. The rationale is that the permanganate of potassa is decomposed by the woody fibre; brown

peroxide of manganese is precipitated and fixed by the potassa, which is afterwards removed by washing with water. The wood, after having become dry, is varnished, and is, according to the author, not readily distinguished from naturally dark-coloured woods.

Comptes Rendus des Séances de l'Académie des Sciences, November 2, 1869.

This number contains the following original papers and memoirs:—

Industrial Use of Mineral Oils for the Purpose of Heating Steam Boilers, and particularly Locomotive Engines.—MM. St. Claire-Deville and Dieudonné.—This paper gives an interesting account of a series of experiments made by the authors with locomotives upon the French Eastern Line (Paris to Strasbourg), with a speed of 46 kilometres (about 29 miles) per hour, and upon a portion of the line of railway which is by no means level. The consumption of mineral oil was from 3·44 to 5 kilos., per kilometre, over a total distance of 142 kilometres, run over with heavily-laden trains. The authors state that the combustion was very complete.

Heating of Wines.—M. Thenard.—This subject, which has been repeatedly before the meeting, seems to have given rise to some jealousy, as well as captious controversy. The author of this paper, acting upon the principle. "*Qui bene distinguit bene docit*," states that M. Appert first discovered the principle, that M. Pasteur has given a proper scientific explanation thereof, and that, lastly, M. Vergnette has been the first man who has industrially applied this principle on the large scale with good success.

Asia Minor.—M. Tchihatcheff.—This author presents to the Academy the last, that is, the eighth, volume of his great work concerning a hitherto very imperfectly known part of the globe. This volume comprises the physical geography, climatology, botany, and geology of the above-named country. The author's work is highly eulogised, and is a very valuable contribution to science.

The Chalk of Northern Europe.—M. Hébert.—A lengthy paper on an important geological formation which the author distinguishes according to the presence or absence of some animal remains into groups of different ages.

Chemical Researches of Various Combustible Gases Naturally Occurring in Central Italy.—MM. Fouqué and Gorceix.—The authors have investigated twenty-eight different kinds of gas, collected chiefly in the Appenine Mountains between Modena and Imola, including four different kinds collected at the Lagoni, which yield boracic acid. As instances of the composition of these gases, we quote:—Barigazzo—CO_2, 1·58; N, 1·81; C_2H_4, 96·61. Sassuno—CO_2, 1·14; N, 0·39; C_2H_4, 80·60; C_4H_6, 17·87. Gases from the Lagoni:—Larderello—HS, 4·20; CO_2, 90·47; N, 1·90; H, 1·43; C_2H_4, 2·00. Serrazzano—HS, 6·10; CO_2, 87·90; N, 2·93; H, 2·10; C_2H_4, 0·97. This lengthy paper contains a very interesting account of the localities where the gases have been collected, and is a valuable addition to chemical geology.

A Measure which is Not Effected by Change of Temperature.—M. Soliel.—This author proposes (*rasum teneatis amici*) to use beryl, the precious stone, as a suitable material for the construction of a standard measure of length, on account of its exhibiting peculiar properties on being submitted to changes of temperature, whereby it is possible that, under certain condition, it will remain invariable. Unfortunately, there are no beryls found of a metre in length, and, therefore, only a centimetre standard could be made.

Constitution and Motion of Glaciers.—MM. Grad and Dupré.—The chief results of the labours of these authors are the following:—The crystals of ice of the glaciers are arranged in a regular manner, and the constituent molecules of that ice are placed as in frozen water. The velocity of motion of a glacier increases from the bottom to the top, while the maximum of motion coincides with the greatest slope.

Heat Reflected from the Moon's Surface.—M. Baille.—According to this author, the moon's surface emits as much heat as a cube filled with boiling water, covered with lamp-black, having a surface of 6·5 square centims., and placed at a distance of 35 metres from the thermo-electric measuring apparatus employed by the author for his experiments.

Synthesis of Guanidine.—M. Bouchardat.—Four volumes of ammonia gas, and one volume of chloroxycarbonic acid, act upon each other with energy, producing chloride of ammonium and urea—

$$C_2O_2Cl_2 + 4NH_3 = C_2H_4N_2O_2 + 2(NH_4Cl).$$

On repeating this experiment, the author also obtained urea, but, simultaneously, divers carbonic acid amides, and especially, also, guanidine. The author has operated with large quantities, no less than 150 litres, of chloroxycarbonic acid at the same time, and has obtained thereby:—(1) Guanidine, the sulphate of which corresponds, in composition, to the formula $S_2O_6 2(C_2H_5N_3)H_2O_2$. (2) Urea. (3) Melanuric acid, a white-coloured substance, insoluble in water, soluble in weak aqueous solution of caustic potassa, nitric, and hydrochloric acids; formula, $C_6H_4N_4O_4$. (4) Cyanuric acid.

On Chloral.—M. Bouchat.—During the discussion which followed the reading of this paper, it was incidentally mentioned that M. Personne, director of the chemical laboratory of the Ecole de Pharmacie, Paris, had instituted a series of experiments with chloral upon animals, with the result that chloroform was readily detected in various fluids of their bodies, after the administration of chloral.

Anti-Cholera Tissue.—M. Adeline.—This author, or rather manufacturer, having learnt that, from the experiments and experience of Dr. Burq, copper is a certain antidote against Asiatic cholera, presents samples of various woven fabrics, wherein a certain quantity of copper wire is introduced for the purpose of serving as prophylactic.

Phosphorescence of the Sea.—M. Duchemin.—According to this author, that phenomenon is due to electricity, and the infusoria only act as sharp points do in well-known electrical experiments.

Useful Application of Arsenious Acid.—Dr. Lisle.—If the statements of this physician are confirmed, arsenious acid will become a great boon to a large number of people afflicted with that most dire disease—mental derangement. According to this author, arsenious acid, properly administered, even in apparently hopeless cases, restores about 66 per cent of the afflicted to health.

Cosmos, October 30, 1869.

From this number we abstract:—

Extraction of Benzol from Coal-Gas.—M. Meunier.—All coal-gas contains the vapor of benzol in more or less quantity. By means of cooling mixtures, pressure, and the use of some chemical reagents, as, for instance, strong nitric and sulphuric acids, chlorine and bromine, benzol may be withdrawn, more or less completely, from coal-gas. It appears, however, that the following simple and effective plan, suggested by the author, answers the purpose far better, since it is by a simple application of a solvent that the benzol is obtained:—The gas is made to pass slowly through coal oils (liquid hydrocarbons), the boiling point of which is higher than that of benzol; but it has been ascertained that petroleum, paraffin oils, schist oils, and even fixed fatty oils will answer this purpose equally well. After a time, these fluids become saturated with benzol, and the latter is obtained by fractional distillation. It should be borne in

mind, however, that gas thus deprived of benzol and its homologues loses a great deal of its illuminating power, even so much, in some instances, as to be only fit for heating purposes.

Saccharimetrical Congress at Berlin.—There has just been held at Berlin, under the presidency of the well-known Dr. Scheibler, a meeting of some twenty-five chemists, whose chief occupation is the investigation and analysis of raw sugars. The aim of these gentlemen, to fix upon a uniform method for all quantitative estimations of sugar, and thus to insure good and conformable results, has been accomplished. Special committees have been appointed to investigate everything relating to the optical saccharimetry. One of these committees undertakes to investigate thoroughly the optical power of different thin plates of quartz in reference to pure sugar; another committee, again, is engaged in the preparation of a standard sample of pure sugar, and superintending the manufacture of perfect and uniform optical saccharometers to serve as standards. A central laboratory is to be established, with branch establishments at various localities in Germany.

Temperature of the Human Body.—The average maximum temperature of adults above twenty-five years is 37·25°; below that age, 37·1°. The temperature of the human body is subject to diurnal variation—from 6 p.m. until midnight, the temperature decreases, and increases again from 3 a.m. until 9 a.m.; this variation is, on an average, 0·49°. A thermometer placed under the tongue indicates about 40°.

Guano from the Chincha Islands.—According to what the editor of *Cosmos* states to be reliable information, the quantity of Peruvian guano is so rapidly decreasing that it is no longer difficult to calculate beforehand the period at which there will be no more forthcoming. The deposit of the Guanope isles, which is, however, of inferior quality, will last for some ten years to come. After that period, the Lobo islets may yield some of this manure; but it has been ascertained that the deposit there found is relatively very poor in ammoniacal salts, and contains, moreover, very much sand.

Vulcanised Caoutchouc.—M. Mouton.—In order to give to vulcanised caoutchouc all that softness which is requisite, for instance, for printing-ink rollers, the author reduces ordinary vulcanised caoutchouc to powder, places it in suitably-shaped vessels, and submits it a second time to the temperature required for vulcanisation. By this means it is rendered soft and smooth, has entirely lost its usual harshness, and is fit for various uses—among these the making of durable printing-ink rollers.

November 6, 1869.

This number contains the following original papers:—

Description of an Oven for Burning Pottery and other Ceramic Pastes.—M. Hofmann.—The contrivance here alluded to is an improvement upon those hitherto in use, which cannot be continuously used, but are only worked by interrupted periods. The furnace, or oven, here described is, in exterior appearance, somewhat like a large lime-kiln; but its interior construction consists of compartments, separated by double walls made of fire-bricks. The consumption of fuel of these ovens is stated to be small. With a circumference of 120 metres, each compartment of the contrivance alluded to is capable of containing 10,500 bricks, and about 4½ millions of bricks can be annually fired by this oven, with a saving of from 50 to 60 per cent of fuel as compared with the old methods.

Preservation of Telegraph Poles.—M. Delarge.—The preservation of the large number of wooden poles in use for carrying the conducting wires has become a very important subject. The author reviews the use of the following substances employed for the purpose:—*Sulphate of copper.*—On inspection of a large number of poles treated with this substance, it was found that, notwithstanding nearly twenty years' service, the wood was in a very excellent state of preservation; but it should be added that very much depends upon the kind of timber used for the purpose, and upon the period of the year when it is cut down. *Creosote* is very extensively applied, and, according to a series of comparative experiments, purposely instituted in Belgium, during the years 1861 and 1862, the durability of creosoted timber is considered equal to that treated with sulphate of copper. Creosote, however, is found to be, in many instances, very inconvenient, both on account of the odor it emits, and on account of the injury caused by its corrosive action upon the hands of the workmen. *Chloride of zinc.*—According to the experience of the Netherlands officers of the Waterstaat, to whom is confided the *matériel* of the telegraphic lines of that kingdom, the use of chloride of zinc has given great satisfaction in the sandy soils of Gelderland; whereas in more calcareous soils chloride of zinc did not answer the purpose at all, a result also observed in Germany. According to the author, there is a good deal of practical experience yet to be gained in this department of chemical engineering, since every day more and more proves that the nature and qualities of the soil wherein the poles and other timber, railway sleepers, etc., are placed, has a vast deal more to do with the preservation of the wood than could be, *à priori*, conjectured.

Annales des Mines, Nos. 3 and 4, 1869.

These two numbers have been issued together, and contain the following original memoirs and papers:—

Mineralogical Tabulated Form.—M. Adam.—This is a concise, but very complete and highly useful, review of the minerals, properly classified in forty-two sections, beginning with hydrogenides, and appendix on meteorites. The table indicates the crystalline shape, hardness, specific gravity, fusibility, and solubility of the various minerals, and contains, moreover, tables of equivalents of the elements and oxidised substances, with the symbols and the quantity of oxygen contained in 100 parts. We, moreover, meet here with a new method for the calculation of the relations of the elementary bodies in any analysis; this may be best explained by quoting the following:—Take, for instance, sulphur, antimony, and silver; the equivalents thereof (O=100) are—S, 200·00; Sb, 1525·00; Ag, 1350·00.

$$\text{Equivalent of sulphur, } \frac{1{,}000{,}000{,}000}{200} = 50{\cdot}0000$$

$$\text{“ antimony, } \frac{1{,}000{,}000{,}000}{1{\cdot}325} = 6{\cdot}5573$$

$$\text{“ silver, } \frac{1{,}000{,}000{,}000}{1{\cdot}350} = 7{\cdot}4075$$

A table being thus made for all elementary bodies, the multiplication by the quotients obtained, of the quantities found by weight as result of the analysis, replaces the division of these same quantities by their equivalents, and yields the same relation; for instance—

Analysis of Miargyrite.

				Rapport, or relation.
Sulphur	21·77	× 50·0000 =	108·850	4
Antimony	41·49	× 6·5573 =	27·206	1
Silver	36·74	× 7·4075 =	27·214	1
	100·00			

The division by the equivalents would have given—

$$\text{Sulphur, } \frac{21{\cdot}77}{200} = 108{\cdot}850,$$

and so on for the other elements. This memoir is a most

valuable addition to mineralogy, as well as to the chemistry of minerals.

On Smoke-Coloured Quartz.—M. Comminges-Guitaud.—This paper, a letter from the French Minister resident at Berne, contains full particulars concerning the discovery and the exploration of quartz of rare beauty, accidentally discovered in the Tiefengletscher of the valley of Urseren, Canton Uri, Switzerland. We have before had an opportunity of quoting this subject.

Use of Sewage Water in Agriculture, according to Experiments and Observations made Abroad and in France.—M. Freycinet.—This extensive memoir, filling some 130 pages, is not suitable for abstraction, but deserves the notice of all parties interested in this subject.

Mineral Resources of Algeria.—M. Ville.—This is a complete treatise on the mineral resources of Algeria, treating of the mineral fuel; iron ores; ores of copper, lead, and zinc; ores of antimony and mercury; the metallurgical works; the salt springs, salines, and deposits of rock-salt; deposits of saltpetre; quarries or layers of gypsum and alabaster; lime-stones; building-stones; brick-clay; clay fit for making pottery; slates; pouzzolanes (natural cements); sand fit for industrial use; mineral and thermal springs, divided into four groups, according to their chemical composition; and, lastly, on the success which has attended the boring for water in Algeria. This paper is an excellent monograph, and it would be highly useful if so complete a review of the mineral wealth of every European country were published.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 142, 1869.

This number contains no original papers relating to chemistry or allied sciences.

Moniteur Scientifique, November 1, 1869.

This number contains the following original communications:—

On So-called Iodine Green.—M. Peters.—The author of this paper states that he has thoroughly investigated this subject, and has overcome the difficulties especially attending the dyeing of wool with the green dye, now rather inaptly called iodine green. The author points out that the following advantages are obtained by his method:—(1) Woollen and mixed tissues can be dyed in a short space of time with very pure shades; (2) the colouring material is not wasted, but entirely exhausted; (3) the expense does not exceed that of the use of the so-called aldehyde green, but the iodine green is purer and faster, while shades of green, either verging upon yellow or blue, can be obtained which are not affected by artificial light. The process of dyeing is described as follows:—Impregnation bath (*bain d'impregnation*)—for bluish green, 25 kilos. of liquid iodine green, for dyeing wool, and 75 kilos. of water; for yellowish green, add 22·5 grms. of crystallised picric acid. When this mixture is brought to the boiling heat, there is placed in it a quantity of previously well washed wool which has been treated with sumac. The wool is left in the bath for about half an hour, and, on being removed, the excess of fluid is got rid of by wringing or, better yet, by the centrifugal machine. The liquid thus obtained still contains a sufficient quantity of colouring matter to be used again. The green-producing bath (*bain producteur du vert*) consists of—Water, 100 kilos.; strong sulphuric acid, 250 grms.; liquid bichloride of tin, 125 grms. This bath is used at a more or less elevated temperature, which depends, in great measure, upon the strength and quality of the tissues or yarn to be immersed therein. Instead of the liquid iodine green above alluded to, and which is not well suited for transport, the author states that, of the iodine-green paste, as met with in the trade, 10 parts have to be mixed with 200 of water; the addition of picric acid may be neglected, and, instead thereof, a small quantity of sulphuric or acetic acid should be added. Fifty parts of the fluid so obtained should be mixed with 150 parts of water; ammonia should be added, and the liquid filtered; after which it is only applicable as an impregnation bath, as above alluded to.

Prophylactic Properties of Phenic Acid.—M. Schiffmann.—The author writes from Valle-Menier, Nicaragua, Central America, stating that, after a very severe epidemic of Asiatic cholera, which caused, during fifteen months, the death of a large number of people, he commenced the use of phenic acid (carbolic acid), causing all the rooms and passages of his house and gardens to be daily watered with water to every pailful of which a tumblerful of the aforesaid acid had been added. The same plan was adopted in the cottages and gardens occupied by about three hundred people, with the result that not only no more was heard of the cholera, but there was also a cessation of intermittent fever (ague), which had almost continually pestered that locality. The author adds that he observed the extermination of all vermin, and that he also used the acid in agriculture, in order to kill noxious insects, especially ants, which abound in that clime, and do great injury to cacao trees (*Theobroma cacao*). Mixed with paint, the author applies phenic acid to wood-work, which is thus preserved from the attacks of white ants and similar vermin.

On Soaps and the Chemical Analysis thereof.—M. Joffroy.—Several methods have been at various times proposed for the quantitative estimation of the various constituents of soap. The following methods are quoted here:—50 grms of the soap are cut up into thin shavings, and dried in a water-bath until no more loss is experienced on subsequent weighing. 12·5 grms. of the soap, cut into thin shavings, are exposed to the action of the air, in order that the free alkali present may thereby become converted into an alkaline carbonate. The sample is next dried, and afterwards dissolved in strong alcohol. In the residue insoluble therein will be found—(*a*) By means of the balance, the total quantity of free alkali (as carbonate) and other salts; (*b*) by means of neutralisation with a test-acid, the quantity of free alkalies; (*c*) by subtracting the quantity of the latter, the quantity of foreign salts will be obtained—that is to say, chlorides, sulphates, &c., of soda, potassa, and other bases. The alcoholic solution is evaporated to the consistency of a syrup, mixed with water, and decomposed by means of hydrochloric acid, whereby the fatty acids are obtained. These, after having been well washed with distilled water, are dried in a water-bath, and weighed. The aqueous solution from which the fatty acids have been separated is evaporated to dryness, ignited, and the residue weighed. This residue is chloride of sodium in the case of hard or soda soap, and, from the quantity obtained, the soda is calculated. In order to estimate the free fat, that is to say, the fat non-combined with an alkali, 10 grms. of the soap are decomposed with hydrochloric acid; the fatty matter is saponified by means of baryta, and the baryta soap obtained is treated with alcohol, whereby the unsaponified fatty matter only is dissolved. The nature of the fatty acids contained in the soap may be ascertained—that is to say, we may find whether stearic, margaric, or oleic acids predominate—by dissolving 5 grms. of the soap in water, adding to the solution enough sulphuric acid to decompose the soap, and the estimating, by means of a very sensitive thermometer, the melting point of the fatty acids; but it should be borne in mind that this operation only gives an approximate result. Another method of testing soap is the following:—Take 1 grm. of the soap, place it in a suitable vessel (a beaker glass), add ether to it, and next acetic acid in a somewhat smaller quantity. The liquid will separate, after a while, into two distinct layers, the upper of which contains in solution the fatty acids, while the lower layer contains the alkalies and salts, and such substances as might happen to be insoluble in the two fluids just named. By means of a pipette, the fluids are

separated from each other. The ethereal solution is poured into a previously weighed beaker glass and the ether evaporated upon a water bath, and next again weighed with the fatty acids it contains. The aqueous acetic acid fluid is evaporated to dryness, and the quantity of alkali determined according to well-known methods.

Revue Hebdomadaire de Chimie, November 4, 1869.

This number contains the following original papers:—

Apparatus for Distillation and Concentrating Liquids in Vacuo.—M. Mène.—When a closed vessel filled with steam is suddenly and efficiently cooled, this vapour is condensed, and there is produced inside that vessel a perfect vacuum, saving always the tension of the water vapour at the temperature to which it is cooled down. It is according to this principle that an apparatus has been constructed, which is illustrated by wood-cuts, which are essentially necessary to the proper elucidation of the mode of action and arrangement, which is, however, so contrived as to admit of continuous action. The apparatus is made of copper, tinned inside, and is applied with great success to the extraction of the aroma of such plants and parts thereof as cannot, without deterioration of the peculiar fragrancy of the same, be submitted to the ordinary distillation process.

Tubular Germinating Machine for Malt Making.—M. Puvrez-Bourgeois.—The author begins by explaining that preliminary process of beer brewing called malting, which is generally known, although some erroneous opinions are in circulation on this subject. Grain does not, in its healthy and fully ripe state, contain any sugar at all. The process of malting is so conducted that, after the grain has been steeped in water for some hours, and has thereby become quite soft, it is placed on what are technically termed beds, and there kept together in a locality which should not be colder than from 14° to 18°. While spread out on these beds, the grain begins to germinate just as if it were sowed in soil, the radicule makes its appearance. It is necessary, however, to supply to the grain under operation air in sufficient quantity; and, on that account, the grain has to be turned over by means of shovels. The apparatus devised by the author, and illustrated by wood-cuts, is constructed with the view of receiving the grain after it has been steeped: it is put in tubes, which are closed by means of perforated lids, and can be moved by means of machinery. According to experience obtained with this apparatus on the large scale, it is highly satisfactory. The author adds one of the most recent analyses of barley, and of malt obtained therefrom. 100 parts, in dry state, contain, for barley—Dextrine, 5·6; starch, 67·0; sugar, 0; cellulose, 9·6; albumenoid substances, 12·1; fatty matter, 2·6; ash, 3·1. For malt—Dextrine, 8·0; starch, 58·1; sugar, 0·5; cellulose, 14·4; albumenoid substances, 13·6; fatty matter, 2·2; ash, 3·2. During the subsequent mashing process, a large proportion of the dextrine is converted into sugar, and the starch into dextrine. The malt here alluded to is the so-called pale, that is, air-dried, malt.

Composition of Different Kinds of Porcelain.—M. Moron.—The materials used for the manufacture of porcelain vary, as will be seen, considerably. At Nymphenburg, Bavaria, the mass is made up of:—Kaolin from Passau, 65 parts; fine white sand, 4 parts; quartz, 21 parts; gypsum, 5 parts; broken-up biscuit, 5 parts. Vienna:—Kaolin from Zedlitz, 34 parts; kaolin from Passau, 25 parts; kaolin from Unghvar, 6 parts; quartz, 14 parts; felspar, 6 parts; metal (broken and ground-up china), 3 parts. Meissen, Saxon-Prussia:—Kaolin from Aue, 18 parts; kaolin from Sosa, 18 parts; kaolin from Seilitz, 36 parts; felspar, 26 parts: metal, 2 parts. The mixture of materials used at Sèvres is only known to those who have the management of that famous manufactory; the kaolin chiefly comes from St. Yrieux.

Pharmaceutische Zeitschrift für Russland, September, 1869.

This number contains the following original papers and communications:—

Monograph on Inuline.—M. Dragendorff.—This lengthy and exhaustive memoir is a compilation embracing everything relating to this subject. The paper is too lengthy to admit of suitable abstraction.

Chloroform and its Behaviour towards Light and Air.—M. Hager.—The author made a series of researches with commercial chloroform obtained from a firm dealing wholesale in this article. The author's paper is divided into the following sections:—Chloroform of commerce contains, besides real formyl-chloride, other chlorinated compounds, which are not readily separated therefrom. This is proved by the fact that, after the separation of alcohol and water, which are invariably present in all commercial chloroform, a fluid is obtained which begins to boil at from 60° to 61°, and at the end of the distillation boils at 65°. By repeated fractional distillation, it is possible to obtain pure chloroform, which can only be properly tested for by means of its boiling point and specific gravity. Pure chloroform is not decomposed by the action of light only.—When chloroform is exposed to the direct action of the sun's rays, it becomes decomposed, exhibits an acid reaction to test-paper, and there are found, among its products of decomposition, hydrochloric acid, chloroxycarbonic acid, formic acid, and free chlorine. Chloroform is decomposed when air has access to it, even in the dark, although only slowly. A quantity of from 0·75 to 1 per cent of alcohol added to chloroform is sufficient to act as a preservative for keeping chloroform for years, even when exposed to daylight. Chloroform, even if it does not exhibit an acid reaction, may be in a state of decomposition. This decomposition can only be detected by the reaction such chloroform exhibits with ammonia, which then yields with it vapours of chloride of ammonium. The cause and products of this decomposition are not ascertained. The boiling point and specific gravity of chloroform are variously determined by different authors:—The *Pharm. Austriaca.*—Boiling point, 63·5°; sp. gr., 1·49 to 1·5. Dr. Strecker—Boiling point, 61°. M. Limpricht—Boiling point, 62°. M. Biltz—Boiling point, 62·05. Specific gravity—At 10·2°=1·5085; at 15°=1·5020; at 17·75°=1·4971; at 20·0=1·4936.

Action of Iodine upon Arseniuretted and Antimoniuretted Hydrogen.—Dr. Husson.—The author finds that both these gases, when made to pass over iodine, readily yield iodides of arsenic and antimony. The author further suggests that this reaction should be made use of in toxicological investigations. For this purpose, when Marsh's apparatus is used, a small quantity of iodine should be placed in that portion of the tube where, commonly, the metallic mirror is made apparent; that part of the tube is gently warmed, so that the iodine coats the tube; and the gas is then made to pass, care being taken to keep the tube somewhat warm. Should the gas contain arsenic, a yellow-coloured mirror will be at once observed; when the gas contains antimony, an orange-coloured iodide of that metal is formed. The iodide of arsenic yields, when volatilised, yellow-coloured vapours, while the vapours of iodide of antimony are of a deep red hue.

Les Mondes, November 4, 1869.

We learn from this journal that M. Wurtz, the well-known scientific chemist, and Dean of the Medical Faculty of Paris, has been nominated Commander of the Order of the Legion of Honour. Among the number of scientific men who have been decorated as chevaliers of the same order, we meet with the names of MM. Schutzenberger, Friedel, and other well-known scientific men.

Navigation on Canals.—M. Bouquié.—Although this short notice does not exactly belong to the sciences usually treated of in our pages, we cannot refrain from quoting the following curiosity:—The distance from Mons (Belgium) to Paris, by canal, is 350 kilometres. The distance from Cardiff to Singapore is 25,000 kilometres; yet the journeys from Mons to Paris are performed by canal so slowly, that the journey from Cardiff to Singapore, if performed at the same

rate of speed, would occupy eleven years. The coal-laden barges sailing between Mons and Paris make only three journeys during a whole year.

Manufacture of Manganate of Lime.—M. Delaurier.—Manganate of lime, CaO,MnO_3 can be directly obtained by heating together any oxide of maganese, previously reduced to powder, and mixed with slacked lime or chalk in equivalent proportions. The two substances should be intimately mixed, and heated to redness, with contact of air and constant stirring of the mixture, in order to promote the absorption of oxygen. This compound is insoluble in water; it is far more readily prepared than the manganates of soda and potassa, because these are fusible, and, hence, less manageable during the process. The manganate of lime yields oxygen on being heated by itself; and, when treated with sufficient sulphuric acid to convert the lime and manganese into sulphates, two equivalents of oxygen are given off. The waste manganese salts obtained in various manufacturing processes may be usefully applied to the preparation of the manganate of lime.

Apparatus for the Demonstration of the Fall of Bodies.—M. l'Abbé Vassart.

Boiling Point of Water at Localities the Height of which Above Sea Level has been Correctly Determined.—M. Ziurek.—The heights are expressed in metres, the average reading of the barometer at each locality in millimetres, the boiling point in °C. The highest inhabited spot on the globe is the township of Antisana, Peru (4101 metres above sea level)—Barometer, 454; boiling point, 86·3°. City of Quito (2908 metres)—Barom., 527; b.p., 90·1°. Sante Fé de Bogota (2661 metres)—Barom., 5·44; b.p., 90·9°. City of Mexico (2270 metres)—Barom., 5·72; b.p., 92·3°. Hospice du St. Gothard, Switzerland, the highest inhabited locality in Europe (2075 metres)—Barom., 586; b p., 92·9°. Gavarni, France (1444 metres)—Barom., 634; b.p., 95·0°. St. Ildefonse Palace; Spain (1155 metres)—Barom., 657; b.p., 96·0°. Madrid (608 metres)—Barom., 704; b.p., 97·8°. Munich, Bavaria (538 metres)—Barom., 710; b.p., 98·1°. Moscow (300 metres)—Barom., 732; b.p., 99·0°. Rome (46 metres)—Barom., 756; b.p., 99·8°. Berlin (40 metres)—Barom., 756; b.p., 99·8°. As regards London, the enormous size of this province of houses makes it impossible to define, for that great extent, any average. Those portions nearest to the river are no more than about from 3 to 5 metres above sea level (not to be mistaken for what is locally known as Trinity high-water mark), while the more elevated portions are some 30 to 40 metres above the same level.

Comptes Rendus des Séances de l'Académie des Sciences, November 8, 1869.

This number opens with a—

Reply to the Last Note of M. Thenard on the Subject of the Heating of Wines.—M. Pasteur.—The purport of this paper is to refute some erroneous statements made on this subject, about which a great deal more fuss is made than is consistent with its importance.

The Changes which Flowers of Sulphur and Finely-Triturated Sulphur Undergo when Brought in Contact with Certain Soils.—M. H. Marès.—The author of this paper, a wealthy landed proprietor, and a scientific man of some standing, states the following facts:—Since the year 1854, the sulphuring of vines has become a regular practice in a portion of the south of France; on an average, there has been employed about 100 kilos. of sulphur to the hectare (2·471 acres), making, in sixteen years, 1600 kilos., although the quantity has been far larger in some districts. The question as to what becomes of all this sulphur has attracted the attention of the author, who has instituted a series of experiments and observations at Launac, near Montpelier. The main result of these researches is, that the sulphur is transformed into sulphuric acid, even during the dry summer season, in the short space of time elapsing between the beginning of July and the latter end of August. Sulphate of lime is formed, in case the soil is calcareous, as in the instance alluded to. The conversion of sulphur is more rapid in case the soil has been manured, but not a trace of sulphuretted hydrogen is then given off; or, if given off at all, it is immediately decomposed by the porous substance of the soil, and oxidised to sulphuric acid. The author found sulphate of lime even to a depth of 50 centimetres below the surface of the soil, which does not contain any of that salt but the merest trace, it being a well-known fact that Montpelier, and indeed, the greater part of the littoral of the Mediterancan, in Southern France, is made up of a tertiary limestone formation. This mode of the disappearance of the sulphur explains the necessity of constantly repeating the sulphuring operation of the vines. The author observes that it appears that the presence of sulphate of lime is a prophylactic against the attacks of the vines by the *Phylloxera vastatrix*, since the vineyards in the Département de l'Hérault, which have been regularly sulphured, are free from the attacks of an insect which ravages at present the vineyards in the neighbouring departments of the Vaucluse and Bouches du Rhône.

Transformation of the Hydrate of Chloral into Chloroform within the Animal Body.—M. Personne.—According to M. Liebreich, the hydrate of chloral should be transformed into chloroform, when coming into contact with the alkali of the blood, according to the following formula:—

$$C_4HCl_3O_2,H_2O_2 = C_2HCl_3 + C_2H_2O_4;$$

that is to say, that the hydrate of chloral should become split up into chloroform and formic acid. This statement of the Berlin gentleman above named has been found incorrect by several French chemico-physiologists; and, in order to set the question at rest, the author of this memoir has instituted a series of experiments, partly with fresh blood, and partly with live animals, and has also made other crucial experiments, with the result that the hydrate of chloral is really split up—when in contact with blood in a living animal—first, into chloroform and formic acid, which, however, are ultimately converted into chloride of sodium and formiate of soda.

Chloride of Gold.—M. Debray.—The author says, It is a well-known fact that, when chloride of gold is submitted to a temperature of about 200°, it is first decomposed into protochloride of that metal and chlorine, and, if the temperature still rises, into chlorine and metallic gold. It is, however, possible to obtain crystals of chloride of gold by sublimation, by the following process:—A current of chlorine gas is made to act upon gold beaten out to a thin foil (not gold-leaf), placed in a glass or porcelain tube, and heated to 300°, at which temperature the volatilisation takes place and ruddy-coloured crystals of the chloride are obtained. The author observes that Boyle was the first who stated that chloride of gold is volatile, to some extent, without dissociation.

Bronze fit for Sonorous Instruments.—M. Riche.—It appears that, at the request of M. Dumas, in his capacity as President of the Committee for the French Mints, the author has made a series of experiments at the Hôtel de la Monnaie, Paris, on divers alloys of bronze brought from China and Japan, containing tin and copper in the proportion of 20 and 80. There have been cast, at the works just named, bars of bronze containing, respectively, 21·5, 20·0, and 18·5 per cent of tin; these bars have been submitted to hammering at temperatures varying between bright red heat and the ordinary temperature of the air. When cold, this metal is as brittle and as breakable as glass; at from 300° to 350°, a perceptible improvement takes place; and at dull red heat the metal works as easily as iron or aluminium bronze; even under the steam hammer, the metal is flattened without breaking, and may be beaten out to sheets of a millimetre thick, but requires, if hammered, a constant annealing; while under the rolling-mill it is even better and more rapidly wrought. When hot, the metal can be cut as if it were iron or steel; with the latter metal it agrees in having a very fine grain and being very homogeneous.

It can be soldered without difficulty with jewellers' solder The density of these alloys was found to be as follows:—Bronze with 21·5 per cent of tin, after having been cast, sp. gr., 8·938—after hammering, 8929; bronze with 18·5 per cent of tin, cast sp.gr., 8 882—after hammering, 8·938; bronze with 20·0 per cent of tin, cast sp.gr., average of three estimations, 8·914—after hammering, 8·920. These alloys are very sonorous, and similar to that of the Chinese gongs.

Yellow Coralline.—M. Laudrin.—The author states that, according to his experiments, the yellow coralline is as little poisonous as the red dye of that name, also known as peonine.

Sugar Contained in Melons.—M. Petit.—The author has carefully studied the formation, as well as the disappearance, of sugar (crystallisable cane) in various fruits. As regards the melon, the rind never contains any other sugar than glucose; the pulp contains glucose in unripe state; and while the process of ripening is proceeding, cane sugar is formed, and increases in quantity, so as to be very soon in excess of the glucose. The formation of cane sugar begins in the most sour part of the fruit—that is to say, in the pulp surrounding the seeds; the formation of cane sugar is not, therefore, due to the previous existence of glucose, nor does the former result from the latter.

Polytechnisches Journal von Dingler, first number for October, 1869.

This number contains the following original papers and communications relating to chemistry or allied sciences:—

Smoke-Consuming Furnace.—M. Miguet.—The consumption of smoke remains a great desideratum for industrial as well as domestic fire-places; from what is stated in this paper, to which some engravings are added, it appears that a real improvement has been made in this direction by the author, who is not, however, fully acquainted with what has been done concerning this subject in England.

Machinery for the Manufacture of Gas from the more Volatile Portions of Petroleum.—Dr. Petersen.—After referring to the advantages of gas for illuminating purposes in general, the author reviews and describes, accompanied and illustrated by engravings, some mechanism devised by German makers, for making and burning a mixture of air and vapours of what is now called gasoline; sp. gr., 0·682. The apparatus consist mainly of an air-compressing pump and reservoir for air; and for the gasoline, which, in a current of air, if not too cold, is readily and completely volatilised, and yields, on burning from an argand burner, a light equal to 18 standard candles, while the cost is only a trifle higher than good cannel-coal gas. Gasoline, as prepared on the large scale, is quite free from sulphur and ammonia, and its combustion is complete, resulting in the production of water and carbonic acid only. The apparatus, for five lights, costs 100 thalers (£15); for 200 lights, 750 thalers (£112 10s.).

Waters Contaminated with Fatty Matters considered as Feed-Water for Steam Boilers.—M. Tricpike.—The author states that it has frequently been observed that new steam boilers have become quite unfit for service in consequence of getting leaky, and that this defect is due to the fact that the feed-water often becomes contaminated with dirty grease, which is forced into the boilers along with hot water, and is derived from the grease used in packing of the piston-rods and other parts of the machinery. The athor states that the addition of 1 lb. of crystallised soda upon 10,000 lbs. of feed-water is sufficient to prevent the effect ascribed to greasy matter taking place; and this confirms the observations made by MM. Börsig and Farcot, the eminent engine-builders of Berlin and Paris.

Quantity of Metallic Lead met with in Litharge.—Dr. Wittstein.—The author refers to the well-known mode of the manufacture of litharge on the large scale, and states that a colleague of his (an apothecary) had called his attention to the fact that it had often happened to him while making *emplastrum diachylon simplex*, to discover metallic lead in the vessel wherein that operation was performed. The author instituted a series of experiments, which gave, as result, that, whereas some kinds of litharge are quite pure oxide, other samples contained from 1·25 to 3·10 per cent of metallic lead in finely-divided state. Pure litharge, free from metallic lead, should dissolve freely in acetic acid. If the litharge contains lead, it remains insoluble.

Bismuth from Peru.—Dr. Barth.—Since bismuth has become a rather expensive metal, more attention has been paid to the search for its ores. The author obtained a large sample of bismuth from Peru, which, on being analysed, was proved to contain in 100 parts:—Bismuth, 93·372; antimony, with a little tin, 4·570; copper, with a trace of iron, 2·058. This bismuth is very valuable, on account of being quite free from arsenic and sulphur, and is very suitable for pharmaceutical use.

Coal Tar Colours.—M. Chateau.—100 lbs. of coal-tar yield—3 lbs. of raw, and 1½ lbs. of pure benzol. This quantity yields—3 lbs. of nitrobenzol, 2·25 lbs. of rosaniline, 3·37 lbs. of aniline red, and 1·12 lbs. of fuchsine; 1 lb. of pure fuchsine requires 3,000 lbs. of pit-coal. The quantity of coal-tar produced by the entire number of gas works of Europe is sufficient to yield, annually, 53,000 cwts. of fuchsine.

Analysis of an Eatable Clay.—M. Hebberling.—The author obtained, from a friend residing at Berbek, Kedirie, Java, a clay which is eaten by the natives and regularly sold in the markets. In 100 parts, this substance contains:—Silica, 39·711; peroxide of iron, 9·806; alumina, 25·939; lime, 3·025; magnesia, 1·352; protoxide of manganese, 0·591; potassa, 0·572; soda, 3·858; water and volatile matter (including 0·506 per cent of ammonia), 14·801—of this material, 72·792 per cent is insoluble in hydrochloric acid.

Les Mondes, November 11, 1869.

This number contains the following original papers and communications:—

Instructions Given by the Conseil de Salubrite (Board of Health) concerning the Use of Domestic Heating Apparatus.

Rendering Petroleum and Paraffin Oils Uninflammable and Inexplosive.—M. Garnier.—The author somewhat verbosely discusses this subject. The main facts brought forward are that experience has sufficiently taught that the temperature of minimum inflammability at 110° F. (43°) is too low, and that, very properly, that temperature should be altered to 180° F. (82°). The author next states that it is possible to render these oils uninflammable and devoid of smell by a chemical process which is not further explained, but which, while rendering the oils absolutely safe, does not interfere with their proper use and applications.

Oleaginous Plants.—M. Heuzé.—Among the *accusés de réception*, attention is called to a very useful work, treating, in a practical manner, on all vegetables the seeds of which produce oil of any kind, recording the history, cultivation, diseases, and, in one word, everything relating to this subject. The book is highly eulogised as the work of a very competent authority who holds office as Inspector General of Agriculture.

Agronomic Stations and Agricultural Laboratories.—M. Grandeau.

Preservation of Beet-Root.—Count Robrinski d'Arlovetz.—One of the drawbacks of the manufacture of sugar from beet-root has always been, and is yet, the proper mode of preservation of the roots, which, in fact, is a problem not so readily solved, and least of all in countries subject to severe winters, since, if the roots are frozen, they are spoiled. The author is a large landed proprietor in Russia (where,

by the bye, the manufacture of sugar from beet-root is greatly encouraged, it being the well-known policy of the Government of that empire to become, as much as possible, independent for articles of home consumption from other countries). The following conditions are to be complied with for properly attaining this object:—(1) No root should be at more than one metre's distance from a proper current of air; (2) every cubic metre of beet-roots requires at least a surface of 30 square decimetres, freely exposed to air; (3) that the cellars in which the roots are stored be aired every day, and care taken that the temperature therein does not rise above 4°; (lastly) care has to be taken that the roots do not become flabby by evaporation of too much water (10 to 12 per cent of their weight), in which case it would be necessary to water the roots, which, however, is always a dangerous proceeding, since it may lead to putrefaction.

Preservation of Stone by the Use of the Black Oxide of Copper and its Salts.—Dr. Robert.—This paper treats on a very interesting subject. The author proves that the decay of stone, granite, marble, limestones, sandstones—in a word, all natural building stones—is the effect of a concourse of various causes, and that among these a very minute lichen, the *Lepra antiquitatis*, is one of the worst enemies of the stone; and this to such an extent that, for instance, the beautiful marble sculptures of the well-known Parc de Versailles, will, unless proper measures are taken for staying the process of decay, be unsightly and ugly masses of dirt, and quite irretrievably lost as works of art within another fifty years. The author, taking as instances such buildings, at Paris, as the Bourbon Palace, the Palais du Corps Législatif, the Mazarin Palace (l'Institut), the Mint, and others, points out that dust, spider's webs, and the action of rain combine with the minute lichen above alluded to, to call forth the decay of stone, especially of such parts, first, where any sculpture or ornamental carving promotes the deposition of dirt and dust. The author conclusively proves (and brings on instances which every one can see, and which, moreover, are important, in consequence of the length of time which has elapsed since the protective action of the black oxide and salts of copper commenced), that the action of the two last-named substances is, undoubtedly, preservative to stone. In reference to granite, the author states that (and an instance thereof can be seen at Waterloo Bridge) this stone is, also, according to the experience of Egyptian engineers, far more readily affected by a moist climate than one would be led to believe. The obelisk of Luxor, brought from Upper Egypt to Paris, has become blanched and full of small cracks during the forty years it has stood on the Place de la Concorde, while forty centuries had not perceptibly affected it as long as it was in Egypt. Granite, in a moist clime, becomes the seat of a microscopically-small cryptogamic plant, which greatly aids destruction; and it is, moreover, a well-known fact, that the disintegration of this stone, consisting of three separate minerals (quartz, mica, and felspar), depends very greatly upon the thorough and intimate mixture, as well as upon the chemical composition, of the same, each of these minerals, separately, being readily enough weathered.

Cultivation of Sugar-Cane in New Caledonia.—M. Joubert.—It appears, from a letter written by the person just named, that New Caledonia will become a sugar (cane) producing country. There are two sugar works in existence already, and two others are being built; the necessary machinery having been shipped from the Ile de la Réunion. Since it is a well-known fact that Cuba and other countries, from which a very large proportion of the supply of sugar is obtained, are rapidly on the decline, as regards quantity, it is a gratifying fact to find that the country above named will soon be enabled to supply a not inconsiderable amount of this commodity.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 15, 1869.

From the *procès verbal* of the first meeting of this Society held after the holidays, we learn that, among other foreigners, the following Englishmen have been elected members:—Professor Crum-Brown, of Edinburgh, and Dr. W. Kellner, of Woolwich. The president, Professor A.W. Hofmann, alluded, in a few words, to the death of the late lamented Mr. T. Graham, who was an honorary member of this Society. As a token of respect to the deceased *savant*, the assembly rose *en masse*, and a deep silence was observed for a few moments. The president next exhibited to the members a medal made of the alloy of palladium and hydrogenium, sent over by the late *savant* just alluded to, a few days before his death, to Professor Magnus, of Berlin; this medal bears on one side the effigy of Her Majesty Queen Victoria, and on the other side the name of Graham and the words "Palladium-Hydrogenium, 1869." There is added to the medal a short paper, which states that the medal contains 900 times its own bulk of hydrogenium, and, since the thickness of the medal is 1 m.m., a layer of hydrogen of a height of nearly 1 metre is condensed in that thickness of metal.

The following papers were read:—

On Chromates.—M. C. Freese.—The researches on this subject extend over a series of the salts alluded to, beginning with silver. The author distinctly points out that there exists only a neutral and a bichromate of the oxide of that metal, but no basic salt. The protoxide of mercury yields a normal neutral salt. By precipitating an excess of HgN_2O_6 with $K_2Cr_2O_7$, the precipitate obtained is not decomposed by washing with water. There exists only one basic chromate of peroxide of mercury. The older works on chemistry speak of basic chromates of copper of a green colour; the author says that green colour is due to basic sulphate of copper, or to hydrated oxide. The only known and well-defined chromate of copper, $Cu_3CrO_6+2aq.$, is brown-coloured. Cupro-chromate of potassa is produced when cold solutions of $CuSO_4$ and K_2CrO_4 act upon each other; the double salt so obtained is split up by boiling water into K_2CrO_7, and sesquichromate of copper—

$$KrCu_3Cr_3O_{13}+2aq=(K_2Cr_2O_7)+(Cu_3CrO_6+2aq).$$

The chromates of zinc, cadmium, nickel, and cobalt are briefly alluded to, as, also, the basic chromate of protoxide of maganese.

On Sulphine Compounds.—M. Dehn.—The author says—Since it has been proved by M. Oefele that, when sulphide of ethyl acts upon iodide of ethyl, there is formed a monatomic radical, wherein the nitrogen is replaced by sulphur, I have tried to obtain similar compounds from diatomic alcohol radicals, using the sulphide of ethyl and bromide of ethylen as starting-point for my experiments. When these substances are heated in sealed tubes, along with water, to about 130°, two different series of action and products are observed; among these, triethylsulphine-platinchloride was obtained—

$$\left.\begin{matrix} \overset{I}{C_2H_5} \\ \overset{I}{C_2H_5} \\ \overset{I}{C_2H_5} \\ Cl \end{matrix}\right\} S,PtCl_2;$$

also ethylen-diethylsuphine-platinum-chloride—

$$\left.\begin{matrix} \overset{II}{C_2H_4} \\ \overset{I}{C_2H_5} \\ \overset{I}{C_2H_5} \\ Cl_2 \end{matrix}\right\} S_2PtCl_2$$

also trimethylsulphine-bromide, C_3H_9SBr. In 100 parts—Carbon, 22·93; hydrogen, 5·75; sulphur, 20·38; bromine, 50·96. The paper enters into a lengthy discussion on the labours of MM. Cahours, Kolbe, and others on this subject.

Calculation of the Heat Emitted by the Combustion of Organic Compounds.—M. Thomsen.

Contribution to the History of the Salicylic Compounds.—M. Henry.—This is the third portion of a memoir on this subject, subdivided into the following sections:—Nitrile of salicylic acid—

$$C_6H_4\begin{cases}HO\\CN\end{cases}$$

Nitrile of benzoyl-salicylic acid—

$$C_6H_4\begin{cases}(C_7H_5O)O\\CN\end{cases}$$

Metachlorobenzonitrile—

$$C_6H_4\begin{cases}Cl\\CN\end{cases}$$

Metachloronitrobenzonitrile—

$$C_6H_3(NO_2)\begin{cases}Cl\\CN\end{cases}$$

New and General Method for the Formation of Nitriles.—M. Henry.—The concluding portion of a long essay on this subject.

Some Sulphuretted Compounds of Isopropyl.—M. Henry.—This paper treats of:—Sulphocyanide of isopropyl, $C_3H_7.CNS$, a fluid of 0·963 sp. gr. at 20°, boiling at about 150°. Sulphur isopropyl, $(C_3H_7)_2S$, boils at 105°, and enters into combination with several metallic chlorides, the mercurial compound being a crystalline substance of the following formula:—$(C_3H_7)_2S,HgCl_2$. Mercaptanisopropyl, $(C_3H_7)HS$, boils at 45°, and acts energetically on peroxide of mercury, yielding a crystalline compound, $(C_3H_7)2HgS_2$; the alcoholic solution of this substance yields, with salts of lead, yellow-coloured precipitates, with acetate of copper a white-coloured precipitate, and the same with solutions of the salts of peroxide of mercury.

Some Derivatives of Oxybenzoic Acid.—M. Heintz.—The author describes the following substances:—A diethyl-ether—

$$C_6H_4.OC_2H_5.COOC_2H_5,$$

a clear, colourless, oily liquid, boiling at 263°; its sp. gr., at 20°, is 1·0725; at 0°, 1·0875; its co-efficient of expansion is 0·000735. On saponification, this ether yields an acid $C_6H_4.OC_2H_5.COOH$, a solid substance fusing at 137°; it yields salts with potassa, baryta, lime, and oxide of silver. Acetoxybenzoic acid, $C_4H_6.OOCCH_3.COOH$, a solid fusing at 127°, readily yielding salts with alkalies and the alkaline earths. Oxybenzoic-monethyl-ether, a fluid; formula—

$$C_6H_4.OH.COOC_2H_5;$$

freezes at − 12°, but does not become fluid again until at 72°. (All the formulæ here quoted are exactly reproduced from the original.)

Action of Chloride of Mercury upon Sulphocarbanilide and Sulphocarbotoluide at a Higher Temperature.—M. Buff.—After referring to the experiments of MM. Merz and Weith on this subject, the author says—When a mixture of finely-powdered chloride of mercury and sulphocarbanilide is heated to about 150°, the mixture first fuses, next begins to give off a quantity of hydrochloric acid and sulphuretted hydrogen gases, and after the lapse of many hours the mass exhibited the odour of phenylsenföl (phenylated essential oil of mustard); while in the neck of the retort some crystals of hydrochlorate of aniline were found. The mass in the retort was first treated with boiling water, and next with alcohol, leaving a residue of mercury and sulphur; by this process a basic substance, soluble in water, was obtained, which has been called tricarbohexanilide by MM. Merz and Weith, and triphenyl-guanidine by Prof. A. W. Hofmann. This substance fuses at 145°; when it is heated with sulphuric acid, sulphanilic acid is formed. The alcoholic solution yielded a solid crystalline matter, fusing at 235°, and exhibiting all the characteristics of a phenylated urea. When sulphocarbotoluidide is treated in the same manner, but at a temperature between 165° and 180°, a mass was obtained which exhibited a strong odour of oil of aniseed; the mass was at once exhausted with alcohol, yielding, after a complex process of purification, crystals of tritolylguanidine and sulphocarbotoluidide. The formation of tritolylguanidine is explained by the following formulæ:—

$$CH_3-C_6H_4\\H\Big\}N-C-N\Big\{\begin{matrix}C_6H_4-CH_3\\H\end{matrix}\\\|\\N\\C_6H_5-CH_3$$

A New Phosphamide.—M. Wichelhaus.—After referring to the labours of MM. Fittig, Gerhardt, Kekulé, and others, the author points out that, when phosphorus perchloride acts upon benzol-sulphamide, the product of that reaction need not be, as is generally supposed, benzol-sulphamide-chloride. On repeating the experiment, the author obtained, by means of a complicated set of reactions, a substance, $C_6H_6SO_2NPCl_2$; the reaction should, therefore, be represented by the following formula:—

$$C_6H_5.SO_2NH_2 + PCl_3.Cl_2 = Cl_2 + HCl + C_6H_5.SO_2NHPCl_2.$$

The substance resulting from the benzolsulphamide appears to be a phosphamide, and is called by the author *benzol-sulphurylbichlorphosphamide*—

$$NH(C_6H_5.SO_2)\\PCl_2$$

Under the title of "Correspondence," M. V. von Richter writes from St. Petersburgh as follows:—The study of chemistry and the number of scientific chemists has of late years so rapidly increased in Russia that, after a general meeting of scientific men of the empire (held at the capital, in January, 1868), the Government permitted (on the 28th of October of that year) the establishment of a Chemical Society for the empire, upon the conditions that the seat of the Society should be the capital city, and that none but really scientific chemists should be elected as members. The president of the Society is elected for five years consecutively, and this office is held by M. Zinin. The meetings take place monthly, except the three summer months; at the meeting of 11-23 September last the following communications were made:—

Action of Iodine upon the Silver Compound of Succinimide Dissolved in Aceton.—M. Menschutkin.—Iodine of succinimide is obtained in crystals belonging to the quadratic system; at 153°, this substance is decomposed, succinimide being again formed. Iodine does not act upon the sodium combinations of formanilide and acetanilide.

Benzimide.—M. Zinin.—The author states that when this substance (formula, $C_{23}H_{18}N_2O_2$) is heated, along with water, in sealed tubes, it is split up into oil of bitter almonds and the amide of an acid as yet not well determined.

Nitrotoluol.—MM. Beilstein and Kuhlberg—The authors exhibited a series of preparations of this substance; among these, solid nitrotoluol, boiling at 237°, and fluid nitrotoluol, boiling at 221°. The latter yields fluid isotoluidine.

Preparations of Thymol.—MM. Engelhardt and Latschinoff.—When thymol is acted upon by anhydrous phosphoric acid, propylen and γ cresol is formed. This latter substance differs from α and β cresol, which are obtained from two toluol-sulpho acids; but the boiling point of these three cresols is 190°. This concludes the correspondence from St. Petersburgh.

On Ethylenferrochloride.—M. J. Kachler.—When an ethereal solution of chloride of iron is heated for some hours in a sealed tube up to about 150°, a solid greyish-coloured substance is obtained. The author finds that this substance is, after having been purified, a compound

$C_2H_4.Fe_2Cl_2 + 2H_2O$. The formation of this substance is represented by the following formula:—

$$\left.\begin{matrix} C_2H_5 \\ 2C_2H_5 \end{matrix}\right\} O + 2Fe_2Cl_3 = 2(C_2H_4.Fe_2Cl_2) + 2\left.\begin{matrix} C_2H_5 \\ H \end{matrix}\right\} O + 2Cl.$$

This compound is not formed when the ether is perfectly anhydrous, and could not be obtained when, instead of ether, alcohol was used.

Balsam of Peru.—M. Kachler.—The author first reviews the labours of the large number of scientific men who have taken up and investigated this subject; and next describes, at very great length, his experiments, which gave, as result, that 100 parts of this balsam consist of 20 parts of benzile alcohol, 46 parts of crude cinnamic acid, and 32 parts of resin. There is appended to his paper a critical review of the labours on this same subject recently published by M. Delafontaine, from which it appears that the Peru balsam of commerce is a substance of variable composition, as has been very frequently brought forward and proved by scientific as well as pharmaceutical chemists.

Some Derivatives of Succinyl.—M. Weselsky.—The author describes:—Succinyl-phenol—

$$\left.\begin{matrix} C_4H_4O_2 \\ 2(C_6H_5) \end{matrix}\right\} O_2,$$

is insoluble in water; soluble in ether, sulphide of carbon, and benzol; fuses at 118°; and boils and distils over, without decomposition, at 330°. Sulpho-succinate of potassa—

$$\left.\begin{matrix} C_4H_4O_2 \\ K_2 \end{matrix}\right\} S_2,$$

is a solid substance, readily soluble in water, alcohol, and ether, and readily decomposed by acids, sulphuretted hydrogen being evolved. Sulpho-succinic acid, $C_4H_4O_2S$, also called sulpho-succinyl, is very soluble in water, alcohol, and ether, and exhibits a strongly acid reaction; with solutions of salts of copper, it is immediately decomposed, sulphide of copper being formed.

On Biniodide of Phenol.—MM. Hlasiwetz and Weselsky.—In the introduction to this paper, the authors review the history of some isomeric monoiodine phenols, and other compounds of phenol and iodine. Pure biniodide of phenol is a crystalline substance, readily soluble in alcohol, ether, and sulphide of carbon; fusing at 150°; subliming at a higher temperature; formula, $2C_6H_4I_2O + 2H_2O$.

Products of the Oxidation of Toluol-Sulpho Acid by means of Fusing Caustic Potassa.—M. Barth.—This paper, and the next (by the same author).—

Constitution of Phloretinic Acid and Tyrosine—Are not well suited for abstraction.

On Sulphoxybenzoic Acid.—M. Senhofer.—By a lengthy process, too long for quotation, the author obtained sulphoxybenzoic acid in pure state. It is a crystalline bright green-coloured substance, $C_7H_7SO_6$, not precipitated by neutral acetate of lead, and yielding, with chloride of iron, a wine-red colour; at 160°, it loses water; the acid fuses at 208°. This acid forms compounds with lead and cadmium; the latter is an acid salt. Formula, $2(C_7H_5SO_6)Cd$. The acid does not readily form salts with alkalies.

New Mode of Formation of Protocatechuic Acid.—M. Malin.—The author finds that, when sulphanisic acid is heated with fusing caustic potassa in excess, care being taken to regulate the temperature properly, and to avoid a too long continued action of the potassa, the result is the formation of protocatechuic acid; when the action is too long continued, hydrochinon is, however, formed. The acid obtained was found, on elementary analysis, to yield—C, 54·7; H, 4·0. Dried at 100°, this substance lost 10·5 per cent of water. The quantity of protocatechuic acid obtained from 16·6 grms. of sulphanisic acid amounts to about 2 grms.

Pettenkofer's Method for the Determination of Carbonic Acid.—Dr. Gottlieb.—The author states that while, with the method alluded to, the accuracy thereof mainly depends on the care taken in the preparation of the turmeric paper used in this process (which is not described, but understood to be generally known), he has found that, when proper precautions are taken, the pigment of litmus answers the purpose as well. For this purpose, the litmus is exhausted with alcohol at 85 per cent, until it only assumes a very slight violet tinge. The alcohol is removed by evaporation on a water bath, leaving behind a deep violet-coloured amorphous mass, the largest part of which is soluble in cold water, yielding a solution which, on the addition of an acid, assumes the well-known red colour, known as *rouge pelure d'oignon*, while alkalies do not affect it. The remainder of the litmus (insoluble in alcohol) is treated with water, yielding a blue pigment insoluble in alcohol; this aqueous solution is, after removal, by filtration, of the substances of the litmus insoluble in water (impurities), at first, violet-blue coloured; but this tinge changes, on the addition of more water, into a pure blue, which, by the addition of acids, soon becomes beautifully red (*pelure d'oignon*), which tinge, however, does not become apparent unless a larger quantity of acid has been added. The author, therefore, adds to a portion of the blue-coloured fluid guttatim, some very dilute hydrochloric acid, until the fluid has assumed a wine-red tinge. When this point has been reached, the rest of the blue (original) liquid is added; and in this manner a fluid is obtained which answers the purpose of working according to Pettenkofer's method, better than turmeric paper or tincture, since the author states that, on instituting comparative tests and essays, he found it easy to estimate to within 0·0007 grm. of carbonic acid.

Comptes Rendus des Séances de l'Académie des Sciences, November 15, 1869.

This number contains the following original memoirs and papers relating to chemistry and allied sciences.

Researches on the Luminous Effects Due to the Action of Light upon Different Bodies—Refrangibility of the Active Rays.—M. Becquerel.—This is the fifth instalment of a lengthy memoir on this subject. In order to study very completely the mode according to which the exciting action (*action excitatrice*) of the solar spectrum is distributed when made to illuminate bodies not possessed of any great phosphorescence, the author applies a wide-mouthed phosphoroscope. The substance to be investigated is reduced to a fine powder, and fixed, by means of a little gum-water, to a plate of mica. The author's experiments led to the following conclusions:—The most refrangible rays, and principally those beyond the violet, are the most active; the different parts of the solar spectrum differ in their activity; the least refrangible rays from the blue, and past the ultra-red, act especially as extinguishers of phosphorescence.

Petroleum in the Netherlands' East Indies.—Dr. von Baumhauer.—The author gives a complete description of a large number of sources of petroleum discovered in different islands of the Indian Archipelago, which are dependencies of the Netherlands. The author states that, from observations and experiments made, there exists, at 250 metres' depth, an almost inexhaustible reservoir of this fluid.

Facts Relating to Interverted Sugar.—M. Maumené.—The so-called interverted sugar is prepared by the author in the following manner:—Perfectly colourless sugar-candy is pulverised and thoroughly washed, first, with pure ether, and then with perfectly pure absolute al-

cohol; the powder is next dissolved in about five times its weight of very pure distilled water, to which is added 1 c.c. of pure concentrated hydrochloric acid (this quantity of acid is sufficient for the conversion of 1 kilo. of pure sugar). The aqueous solution is heated on a water-bath for a few hours, until colouration just begins to be perceptible. The HCl is removed, by the quantity of oxide of silver required for that purpose, with only five milligrms. excess; the chloride of silver is separated by filtration; the filtered liquid treated with sulphuretted hydrogen, to make perfectly sure of the removal of all metal; the liquid again filtered, and next evaporated upon a water-bath, yielding perfectly pure glucose. The remainder of this paper is a critical review of M. Dubrunfaut's labours, and too lengthy to admit of any useful abstraction.

Lower Lignites of the Plastic Clay of the Paris Basin.—M. Planté.—An interesting paleontological paper.

Chemical Composition and Mode of Deposition of the Layers of the Great Oolite and Forest Marble in the Haute-Marne.—M. Guignet.—After referring, at some length, to the peculiar geological features of this portion of France, the author communicates the analysis of a peculiar kind of soil, which, in 100 parts, consists of—Silica, 50·0; alumina, 15·0; peroxide of iron, 10·0; lime, 2·5; water, 5·0; magnesia, manganese, sulphuric acid, and other non-determined substances, 17·5; the greater portion of this paper is chiefly of local interest.

Permanganic Acid.—M. Delaurier.—After briefly referring to former communications on this subject, the author states—Manganate of lime is produced by heating, with access of air, 1 equiv. of peroxide of manganese, and 1 equiv. of lime. This compound exhibits a brown colour; and when the iguition is continued, the mixture being stirred to promote the access of air, it is converted into permanganate of lime, exhibiting a blackish colour, and being more fusible than the manganate—

$$2CaO,MnO_5 + O = CaO,Mn_2O_7 + CaO.$$

This substance is a powder; and when the author tried to set free permanganic acid from it, by means of two equivs. of sulphuric acid diluted with some water, the heat thereby disengaged is too great, and the permanganic acid is decomposed into sesquioxide of manganese and oxygen; but when fused permanganate of lime is applied, the action of the sulphuric acid is slow, and the permanganic acid may be obtained by distillation at a temperature of from 60° to 70°.

This number contains several papers relating to meteorology and luminous meteors—among these, a lengthy account, accompanied with an engraving, of a bolide and its explosion, observed by M. J. Silbermann on the 11th inst., at nearly 11 p.m.

Annalen der Chemie und Pharmacie, October, 1869.

This number contains the following original papers and memoirs:—

Researches on the Essential Oil of the Fruits of Heracleum Spondylium.—M. Zincke.—The essential oil was obtained by distilling, with water the fruits of the *Heracleum spondylium*. 80 lbs. of the fresh fruits yielded 120 grms. of oil; the water which came over with the oil exhibited a very strongly acid reaction to test paper, and was, therefore, also subjected to investigation. The essential oil which was obtained was of a bright green colour, very fluid, and exhibited only a slight smell, which was rather pleasant; its taste was burning and acrid; sp. gr. at 20°, 0·864; slightly acid reaction to test paper; did not yield, when treated with a concentrated solution of bisulphite of soda, any crystalline substance (stearopten); submitted to fractional distillation, there were obtained two portions—one (about 14 grms.) came over at from 190° to 195°, the other portion (of about 40 grms.) came over at 206° and 208°. This last portion exhibited a perfectly clear neutral fluid, insoluble in water, but miscible with alcohol and ether; sp. gr. at 16°, 0·8717; formula, $C_8H_{16}O$. This portion of the oil turned out to be, on further investigation, an octyl-alcohol; formula, $C_8H_{18}O$. The following derivatives of octyl-alcohol were investigated:—Chloroctyl, $C_8H_{17}Cl$; bromoctyl, $C_8H_{17}Br$; iodoctyl, $C_8H_{17}I$; octylic acid-octyl ether, $C_8H_{17},C_8H_{15}O_2$; benzoic acid-octyl ether, a colourless fluid, exhibiting an aromatic odour, boiling at about 306°, insoluble in water, but readily soluble in alcohol and ether. The investigation of the first portion of the oil (boiling between 190° and 195°) proved it also to contain an octyl-alcohol, but along with it some substances the nature of which could not be ascertained with certainty. The acid-water above alluded to was found to contain acetic and capronic acids.

Synthesis of a Hydrocarbon of Ethyl-Vinyl isomeric with Butylen.—M. Wurtz.—In order to prepare hydrocarbons synthetically, the author causes zinc ethyl to act upon organic bromine or iodine compounds. Zinc ethyl and bromated ethylen are mixed, and heated to 140° in sealed tubes, and next left standing for several weeks. Previous to opening the tubes, these should be placed in freezing mixture, and the gas which is given off when the tubes are opened is made to pass into bromine. The bromated compound thus obtained is a perfectly clear liquid, boiling at 166°; sp. gr., 1·876. When this bromated compound is treated with sodium, ethyl-vinyl is set free; this substance is a fluid boiling at −5°.

Researches on the Constitution of Piperine and its Products of Decomposition, Piperinic Acid and Piperidine.—MM. Fittig and Mielch.—This memoir, of which the first instalment is here given, is divided into the following sections:—1. Preparation and properties of piperinic acid.—This acid is prepared by gently boiling, for about twenty-four hours, a mixture of 1 part of piperine, 1 part of caustic potassa, and 5 parts of alcohol, yielding piperinate of potassa. The authors have tried to split up piperine by means of hydrochloric acid; this method, however, proved unavailable, since there were by-products formed which destroyed nearly all the piperinic acid. Piperinic acid, when pure, is a colourless solid substance, fusing between 212° and 213°; when submitted to distillation along with excess of lime, phenol is among the products of the decomposition. 2. Experiments made in order to solve the question whether piperinic acid contains HO or CH_3O,C_2H_5O, etc.—From the lengthy series of experiments instituted by the authors, the conclusion is that piperinic acid is a monobasic as well as a monatomic acid. 3. Products of the oxidation of piperinic acid.—(*a*) Behaviour of piperinic acid towards chromic acid. (*b*) Behaviour of piperinic acid with permanganic acid in neutral solution. Piperonal is one of the chief products of the oxidation of piperinic acid; formula of piperonal, $C_8H_6O_3$. Piperonylic acid, $C_8H_6O_4$, stands in the same relation to piperonal as benzoic acid to oil of bitter almonds. (*c*) Action of nascent hydrogen gas upon piperonal and piperonylic acid. (*d*) Piperinic acid and nitric acid. 4. Action of bromine upon piperinic acid. 5. Hydro-piperinic with oxidising substances and bromine.

Researches on the Creosote obtained from Rhenish Beech-Wood Tar.—M. Marasse.—From the introduction to this paper, we learn that there exists some difference between the creosote obtained from beech-wood grown along the Rhine and that grown in a portion of Southern Germany. Both kinds of creosote contain guaiacol, $C_7H_8O_2$, and eresol, $C_8H_{10}O_2$, and, moreover, in addition thereto some other substances not containing oxygen. The author's researches on the Rhenish beech-wood tar prove that there are contained in that liquid—guaiacol, eresol, phenyl-alcohol, and substances homologous therewith. The lengthy essay is divided into the following sections:—(*a*) Researches of the fluids boiling below 199° (the raw material operated on was a rectified creosote of commerce of excellent quality, manufactured by MM. Dietze and Co.,

[English Edition, Vol. XX., No. 522, pages 262, 263.]

operative chemists, at Mainze); (*b*) action of powdered zinc upon creosote boiling between 200° and 203°; (*c*) action of fusing caustic potassa upon creosote of the same boiling point; (*d*) action of hydrochloric and hydriodic acids upon that same creosote; (*e*) preparation of the methylic ether of cresylic alcohol and of the neutral methylic ether of pyrocatechnin; (*f*) action of hydriodic acid upon creosote boiling at between 217° and 220°; (*g*) action of hydrochloric acid and chlorate of potassa upon guaiacol; (*h*) action of the last-named chemicals upon creosote boiling at between 200° and 203°. The author of this paper adds a foot-note, of the following purport:—It is generally taken for granted that the use of chromate of lead, in the elementary organic analysis, is preferable to that of oxide of copper whenever the complete combustion of difficultly-combustible substances has to be provided for; but the author found that in the case of cresylic alcohol (even when a current of oxygen is made to pass through the combustion-tube towards the end of the operation), its complete combustion is impossible. As the cause for this phenomenon, the author assigns the fact that a portion of the chromate of lead is entirely reduced to the metallic state, and that this lead retains carbon, preventing its combustion. It is, perhaps, not out of place here to observe that this same observation was made about thirty years ago by the late Berzelius, who therefore advised the admixture of pure and carefully-fused bichromate of potassa in small quantity to the chromate of lead.

Products of the Oxidation of Toluol-Sulpho Acid by Fusing Caustic Potassa.—M. Barth.—The author obtained, by this reaction, paraoxybenzoic acid, salicylic acid, cresol, and other substances. Paraoxybenzoic acid fuses at 210°, and crystallises in prismatic-shaped large white-coloured crystals; formula, $C_7H_6O_3+H_2O$.

Constitution of Phloretinic Acid and Tyrosine.—M. Barth.—When phloretinic acid is submitted to fusion along with excess of caustic potassa, the author obtained a substance, $C_7H_6O_3+H_2O$. On further investigation of this subject, the author came to the conclusion that there exist two acids—

$$C_6H_4\begin{cases}OH\\C_3H_5O_2\end{cases}$$

each of which yields, on becoming oxidised, paraoxybenzoic acid. Tyrosin, when pure, also yields, on fusion with caustic potassa, the same acid. The theoretical reasonings of the author, concerning the constitution of tyrosine—

$$C_6H_3\begin{cases}OH\\NH.C_2H_5\\COOH\end{cases}$$

are too abstruse to be suitable for abstraction.

Decomposition of Acetate of Silver under the Influence of Iodine and a High Temperature.—M. Birnbaum.—After reviewing the labours of MM. Weltzien, St. Claire-Deville, Bourgoin, and others who have experimented on this subject, the author states that he obtained, by causing iodine to act upon acetate of silver, chiefly two substances—viz., a fluid, and a mixture of gas, chiefly carbonic acid; the fluid is acetic acid, while among the gases ethyl and acetylen could be readily detected. When the rather violent reaction is moderated, the author found that the following products are formed:—Iodide of silver, acetate of methyl, acetic acid, carbonic acid, acetylen, hydrogen, and sometimes silver and carbon. The quantities of these substances vary considerably, and it is the author's opinion that this should indicate that several reactions are going on at the same time. The reaction may be represented by the following formula:—

$$2CH_3COOAg+I_2=CH_3COOH+CH_2+CO_2+2AgI;$$
$$2CH_2=C_2H_2+H_2.$$

Acetate of silver, when in aqueous solution, behaves with an aqueous solution of iodine in a different manner, and the reaction is expressed by the following formula:—

$$6C_2H_3AgO+6I+3H_2O=6C_2H_4O_2+5AgI+AgIO_3.$$

On Sulphate of Amarine.—M. Groth.—The author first refers to M. Laurent's researches on this subject, and then says that he could only experiment with a very small quantity of the above-named substance, which had been forwarded to him more for crystallographical than for chemical research. Sulphate of amarine is tolerably soluble in water; its water of crystallisation is driven off at about 110°; composition, $2(C_{21}H_{19}N_2)2SO_4+7aq.$

Formation of Phenols when Chloride of Zinc Acts upon Camphor.—M. Rommier.—According to the late M. Gerhardt camphor is converted into cymen and water by distillation with chloride of zinc, according to the formula $C_{20}H_{16}O_2=C_{20}H_{14}+2HO$. Very many experimenters—among them, MM. Lippmann, Longuinine, Fittig, &c.—have found it either impossible, or, at least, very difficult, to obtain this result. The author states that he operated with 2 kilos. of camphor, and obtained about 700 grms. of a volatile oil boiling between 140° and 240°; this oil proved to be a mixture of various substances, among which were cresyl-alcohol, several hydrocarbons, and other products of decomposition, due rather to the high temperature than to the simple elimination of water by the chloride of zinc and high temperature together.

Conversion of the Butyric Acid of Fermentation into Normal Primary Butyl-Alcohol, and into Ordinary Butyl-Alcohol as obtained by Fermentation.—M. Linnemann.—This is only a brief preliminary notice written *pour prendre date*.

Cosmos, November 13, 1869.

This periodical contains the following original papers and communications:—

Estimation of Nickeliferous Iron in Meteoric Stones.—M. Meunier.—There are three methods chiefly in use for this purpose—viz., separation of the metal by means of a magnet; solution of the metal in a solvent, which leaves the remainder of the material composing the stone untouched; and the measuring of the hydrogen set free by the solution of the metal in a confined space. The author has added to these methods of estimation another, which he describes as follows:—When the meteorite to be investigated is very finely pulverised in an agate mortar, there is added to it an excess of a solution of chloride of gold in water, the iron (present in the form of minute particles) is rapidly dissolved, and there is formed a precipitate of metallic gold equivalent to the quantity of iron present. The solution of the iron takes place rapidly, so that after a few minutes the operation is complete. The contents of the small flask wherein the operation took place are placed on a filter and thoroughly washed with water until the excess of chloride of gold is washed out. When this point has been arrived at, the remainder upon the filter is washed with moderately dilute hydrochloric acid, in order to remove the last traces of any chloride of gold adhering to the stony matter of the meteorite; this having been done, the residue on the filter is removed to a small flask, and therein treated with *aqua regia* (nitro-hydrochloric acid), and the quantity of gold estimated in the liquid by well-known methods. By multiplying the weight of the gold thus obtained by the rapport of the equivalents of gold and iron, that is to say, by—

$$\frac{28}{98\cdot18}=0\,286$$

the weight of nickeliferous iron is obtained. The author states that he has tested this process, and compared it with the others above alluded to, and found it to yield very correct results.

Quino-Picric Acid.—MM. Duguet and Perret.—A golden-yellow coloured substance, exhibiting a very bitter taste, difficultly soluble in water, but readily in alcohol;

also soluble in ammonia and the aqueous solutions of alkalies, without decomposition; not perceptibly acted upon by daylight and air when placed in closed bottles. When projected on burning coals, this substance burns off like lycopodium, but does not detonate; on being ignited on platinum foil, no residue is left if the substance is pure. The composition of this material, which is applied as a febrifuge, is stated to be, in round numbers—Alkaloids, 58; picric acid, 42. It is manufactured by acting with picric acid upon those alkaloids of the *cinchonæ* species (viz., quinidine, quinicine, cinchonine, cinchonicine, &c.), which are not used as medicine by themselves, and, in a sense, valueless.

Annalen der Physik und Chemie, von Poggendorff, No. 10, 1869.

This number contains the following original papers:—

Thermo-Chemical Researches.—M. Thomsen.—This is the second instalment of a lengthy memoir. This portion treats of the hydracids of chlorine, bromine, iodine, fluorine, and cyanogen.

Combinations of Alcohol and Water.—M. Mendelejeff.—The second and concluding part of a very lengthy essay on a subject which is of very great importance, both in a scientific and practical point of view, in consequence of the excise duty on spirits. In this portion of the paper, a chapter is devoted to absolute alcohol. After referring to the discrepancies of the specific gravity of that fluid, as determined by different experimenters, the writer proceeds to state that he has reviewed this subject entirely, taking care to obtain alcohol chemically pure (a far more difficult problem than is generally believed); next, also, avoiding, or, at least, taking into account, the very rapid absorption of water and air (absolute alcohol absorbs air readily—100 volumes of that fluid absorb, at 15°, and 760 m.m. barometer, 10·1 volumes of nitrogen and 6·3 volumes of oxygen). The author found the specific gravity of pure absolute alcohol to be 0·79845 at $\frac{20^\circ}{4^\circ}$ C. In order to dehydrate the alcohol, the following substances were tried:—Potassa, chloride of calcium, dried sulphate of copper, anhydrous oxide of barium, sodium-amalgam, and quicklime; the latter is the substance best suited for that purpose. The paper further contains chapters on the contraction of mixtures of alcohol and water, and on the changes of specific gravity of mixtures of alcohol and water.

New Sulpho-Salts.—M. Schneider.—Sulphide of silver and sulphide of iron, $Ag_2Fe_2S_4$; in 100 parts—Silver, 47·38; iron, 24·56; sulphur, 28·06. This compound exhibits the following properties:—Iron-grey coloured shiny crystalline needles, unaltered in dry air, but becoming rapidly rust-coloured when exposed to moist air; not acted upon by very dilute hydrochloric acid, but becoming rapidly decomposed by the action of stronger acid, sulphuretted hydrogen becoming evolved. Heated in a dry glass tube, this compound fuses, and vapours of sulphur are given off, leaving a residue consisting of protosulphuret of iron and metallic silver. Sulphide of sodium with sulphide of iron, containing water, $Na_2Fe_2S_4+4H_2O$; in 100 parts—Sodium, 12·43; iron, 31·07; sulphur, 35·44; water, 19·58. Sulphide of sodium with sulphide of bismuth, $Na_2Bi_2S_4$; in 100 parts—Sodium, 7·79; bismuth, 70·51; sulphur, 21·70. Cuprosulphide of sulphide of potassium with sulphide of copper, $K_2Cu_2S_6$; in 100 parts—Potassium, 10·05; copper, 65·27; sulphur, 24·68. Disodium-cuprosulphide with sulphide of copper, $Na_4Cu_6S_6$; in 100 parts—Sodium, 13·84; copper, 57·29; sulphur, 28·87. Potassic-sulphide of iron with sulphide of copper, $K_2FeCu_2S_4$; in 100 parts—Potassium, 17·28; iron, 12·37; copper, 42·08; sulphur, 28·27. Ferro-sodium sulphide of copper with sulphide of copper, $Na_2FeCu_2S_4$; in 100 parts—Sodium, 10·94; iron, 13·32; copper, 43·50; sulphur, 30·44.

Emission and Absorption of the Heat-Rays Emitted by Bodies at Lower Temperatures.—M. Magnus.—The main points of this paper are:—Different bodies, heated to 150°, emit different kinds of heat; some substances only emit one kind of heat—others, again, various kinds. Pure rock-salt is monothermic; sylvin (chloride of potassium) behaves in a similar manner.

MISCELLANEOUS.

The City of London Gas Act.—We have received from Dr. Letheby his report on the results of the daily testings of the gas supplied to the City during the quarter which ended on the 30th day of September last, from which we find that the maximum illuminating power of the Cannel gas supplied by the City of London Gas Light and Coke Company has been equal to 27·50 standard sperm candles, the minimum to 19·50 candles, and the average to 24·58. The gas supplied by the three companies has been free from sulphuretted hydrogen, but the proportions of sulphur have fluctuated to a large extent. Ammonia has also been found in the gas supplied by the Chartered Company. The use of Sugg's New London Argand Burner of 24 holes shows an increase of illuminating power of sixteen per cent.

University of London.—The following are lists of the candidates who have passed the Second B.Sc. Examination:—*Pass Examination.*—First Division. William Henry Johnson, University College; Alexander Muirhead, University College; William Stephen Ridewood, B.A., private study. Second Division. Phineas Simon Abraham, Trinity College and Royal College of Science, Dublin; William Barnett Burn (First M.B.), St. Bartholomew's Hospital; Dan Isaac Davies, private study; Septimus Peché Moore, LL.B., New and University Colleges; Frederic James Montague Page, Royal School of Mines; Frederick Antony Potter, Royal School of Mines; Charles Thomas Whitmell, St. John's and Trinity Colleges, Cambridge; William Henry Willans, University College and Royal School of Mines.

Production of Oxygen Gas.—Five hundred pounds of manganate of soda furnish two and a half cubic yards of oxygen every hour. This charge is placed in a retort, and superheated steam passed over it; in *five minutes* all the oxygen is extracted from this quantity of the salt. Hot air passed over this residue for *five more minutes* restores all the oxygen given up, and the result of an hour's continuous work, or six extractions of oxgen and six re-oxidations, is two and a half cubic yards of oxygen. This oxygen, when it issues from the gasometers, contains about fifteen per cent of nitrogen, but, by letting the first portions escape, the quantity of this mixture can be reduced to two and a half per cent. M. Tessie du Mothay affirms that one ton of manganate of soda will yield one hundred cubic yards of oxygen daily, or more than 36,000 per year, *and this without having to renew the salt once.*—R. J. Fowler, *in the British Journal of Photography.*

Obituary.—We regret to have to record the death of Dr. Frederick Penny, the Professor of Chemistry in the Anderson Institution, to which chair he was elected in July, 1839. His published papers and researches, as well as his great success as a teacher of chemistry in Glasgow, testify to his ability as a chemist and physicist; and his loss will be felt by a numerous circle of students and friends.

NOTES AND QUERIES.

Halliday's Machines.—"A. W. N." will find, we think, the information he desires in Richardson's, Knapp's, and Watts's work on "Chemical Technology."

Tungstate of Soda, &c.—(Reply to "J. C.")—This article is not manufactured in such large quantities as to require special makers—some few manufacturing chemists make it, and also the tungstate of chromium; but we cannot name any who do so continually. If "J. C." wants these articles, he should either apply to those who sell chemicals, or to some manufacturing chemist, whose names can be found in directories.

Footpaths.—"Roadway" will find one part of Portland cement, mixed with seven or eight parts of gravel, or old hard durable rubbish, such as brick bats, broken stones, or gravel, to make a cheap, neat, permanent, garden walk, impervious to wet, heat, or cold. I will give your correspondent any information he needs if he sends his address to me through you.—Nemo.

Footpaths.—(Reply to "Roadway.")—Your question is one which belongs to civil engineering, rather than chemistry; you do not state a very important item—viz., the natural soil you wish to make a footpath on. A very good and, comparatively, cheap footpath may be made by laying down, first, a layer of rather coarsely broken-up old bricks, next, some middling coarse gravel, and over that a layer of from 2 to 4 inches thickness of small sea-shells (bivalves). If care be taken to beat or roll the broken-up bricks and gravel well into a solid mass, the shell-covered surface may be advantageously rolled in with a heavy iron roller, and will be found to form, even on soft sub-soil, a durable and inexpensive roadway. On the continent, at least in Belgium and the Netherlands, many roadways, *chemins vicinaux et communaux*, are thus arranged, and stand moderate horse and carriage traffic admirably well. Care should be taken for the proper drainage of such roads.

Bichromate of Potash.—In answer to "Bichrome," in your last number, this article is made by Norris, Brothers, Sowerby Bridge, near Halifax; The Conacher Quay Chemical Company, 121, Newgate Street, London; by a Company at Drontheim, in Norway; and also at Baltimore, U.S. If your correspondent wants further information, and writes to me under cover to you, I will ascertain the other addresses.—Nemo.

Terra Alba.—"Selenite" thanks "Nemo" for information given and offered, and would ask further—Is any particular variety of gypsum preferred? what is the nature of Jullien's process? what precipitation is meant? how is drying effected? Is the patent English? Also—If the purest gypsum answers, why the artificial product? what is the difference in cost of production of native and artificial? why is French better than English terra alba? any objection to mention uses of material?

By-Products Containing Soluble Phosphates.—Will any of your correspondents give information as to where any by-products can be obtained containing 3 per cent and over of soluble phosphate?—Arthur Warner.

Preventing Moisture in Glass Cases.—Wishing to enclose a philosophical instrument in a second outer case of glass, where moisture is an enemy, can any correspondent inform me which is the best material to use, chloride of calcium, quicklime, $HO+SO_3$, dehydrated alcohol, or a small stick of sodium (to be scraped occasionally)?—S. E. P.

Bisulphite of Lime.—How is the "bisulphite of lime solution" which is now largely sold, possessing as high a gravity as 1·072, practically made?—A. N. Palmer.

Shoddy.—Can any of the subscribers of your valuable journal inform me the best means of reducing shoddy by acid, for mixing with phosphatic material as a manure.—Child.

Preventing Moisture in Glass Cases.—(Reply to "S. E. P.")—Use quick-lime, which absorbs both moisture and carbonic acid, and put in the case a piece of camphor wrapped in muslin, and you will not be troubled with moisture.

Standard Verification.—(Reply to "S. E. P.")—We believe that a polite application to the Astronomer Royal would obtain you what you desire; there is no doubt that at the Observatory they have the means as well as the good-will to give every assistance for such objects.

Bleaching Syrups.—(Reply to "Andrew Van Bibber.")—You can hardly expect to attain your object at all, since the colour of these syrups is due, in the first place, to caramel, and also to peculiar impurities, from which the sugar is only liberated by a process of washing with a very concentrated, and quite colourless, syrup made on purpose from best refined sugar. Filtration through charcoal (animal) will decolour these green syrups, as they are technically called, to a limited extent, and then only after having been somewhat diluted with hot water, and the filtration taking place in a room where the temperature should not be less than 80° F. By means of very finely divided pipe-clay, added previous to filtration, you may obtain a greater degree of decolouration, but it is impossible to bleach, as you call it, these syrups entirely, and since you have to dilute with water before filtration, you would have to evaporate that water afterwards, and unless that were done in a vacuum pan, your previous operations would be of little avail.—X.

Detection of Prussian Blue in Black Ink.—Prussian blue is either neutral or basic. Neither of these are soluble in water; for, although it is stated that the basic blue is soluble therein, this is incorrect, since the apparent solubility is due to an excess of the ferrocyanide of potassium. There is no means of dissolving Prussian blue but by the use of acids, which would altogether destroy, and be incompatible with, black ink as usually made, since these acids are just those which are used to obliterate the stains of black ink. Prussian blue is decomposed by alkalies; but these would also destroy ordinary black ink. It is not very likely that ink should be tinged blue by Prussian-blue; it is probably coloured blue by a few drops of indigo carmine. As to the detection of logwood in ink, it should be borne in mind that almost all black inks are partly made with logwood, and that a tolerably good black ink is made of logwood decoction and neutral chromate of potassa. The detection of logwood is based upon the reactions of hæmatoxyline and hæmateine, but the details thereof are too lengthy to be here quoted, and can be found in works on organic chemistry.

Terra Alba.—In further reply to "Selenite," it depends upon what purpose he intends or wishes to apply it—which variety is to be preferred. Chemically, they are all the same, except that the commoner kinds contain more or less foreign matter, such as oxide of iron, &c., The best kind is carefully picked out and ground into what is technically termed "terra alba," and by some people "pearl white;" this portion is so white that it looks like good loaf-sugar. The more coloured varieties, or parts of the vein (*i. e.*, the pieces rejected as unfit for terra alba), are ground up separately, and are technically called gypsum. These kinds need no drying; but when either kind is baked, so as to lose its water of crystallisation, it becomes the setting plaster, known as plaster of Paris, used by plasterers. Terra alba (*i. e.*, the natural product) is sold very much cheaper than the artificial one made under Jullien's patent. French artificial sulphate of lime is made like Jullien's, by precipitation, I think, by Prof. Kuhlmann, but it is no better than native terra alba, or Jullien's pearl-hardening. As the artificial article would, if over-dried, lose parts of its water of crystallisation, it is never thoroughly dried. It is almost impossible to enumerate the many uses to which gypsum (a term which includes the whole) is applied; it is, however, largely used for manure, as an absorbent of ammonia, by colour makers, paper makers, and several other trades. Large quantities of the commoner kinds are made in Carlisle and that neighbourhood, and quantities of the stone are shipped from the Seine, to Leith and other places, where it is ground, but the French stone is not good enough to make terra alba. If "Selenite" sends me his address, I will send him a pamphlet on the subject, containing the largest amount of information he can get about it, and which would be too much to be given through your columns. Jullien's patent is an English one.—Nemo.

Bisulphite of Lime.—(Reply to "A. N. Palmer.")—This substance is made by passing a current of sulphurous acid gas into milk of lime until a clear liquid is obtained and the lime dissolved. Care should be taken to wash the sulphurous acid.

Shoddy.—(Reply to "Child.")—Use nitric acid; this will have the effect you desire, of reducing the woolly substance to a pulpy mass, converting it into xantho-proteic acid, which is valuable as manure. By applying the acid named, you can somewhat reduce the quantity of sulphuric acid for dissolving phosphates.

Aluminium Sulphide and Phosphide.—I wish to obtain a small quantity of sulphide and phosphide of aluminium, and should feel greatly obliged if you could inform me where it is probable I could obtain them. I have tried most of the London retail houses, but without success, neither have I been successful in making these compounds, though following the methods described in Watts's "Dictionary," vol. i., rather strictly. Perhaps you could likewise inform me where I could find the processes described in greater detail.—D. H.

The Atomicity of Aluminium.—Would some kind reader oblige an intending candidate for examination by communicating the most rational view of the atomicity of aluminium? Miller classes it as a triad, while Williamson states it to be of "even atomicity;" Roscoe called it tetratomic, but has withdrawn that assertion from his last edition. Messrs. Mottershead profess to follow Roscoe in their chemical labels, but give the symbol for alum $Al(NH_4)_2SO_4+12H_2O$. This, I presume, is a misprint (though still remaining uncorrected); but why should the single formula be given, instead of the double one of the books?—Dubitans.

By-Products Containing Soluble Phosphates.—(Answer to "Arthur Warner.")—It is not at all likely you will meet with any such by-product, unless, perchance, in the mother liquor of phosphate of soda manufacture; but phosphoric acid is too valuable a substance to be negligently dealt with. There is a method of extracting gelatine and glue from bones, whereby the latter are first treated with a moderately strong hydrochloric acid which dissolves the mineral matter of the bone, and, consequently, contains all the phosphates thereof in soluble state; but where you could obtain such liquor we are unable to say; perhaps glue and size makers would be able to inform you.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

R. Tutlock.—Communication received with thanks.

D. W. L.—Bloxam's "Laboratory Teaching," published by Churchill will answer your purpose best.

J. B.—(1) A good cement for sulphide of carbon prisms is isinglass dissolved in weak spirit. (2) Heat and good ventilation will remove the smell of wood-tar from a room.

Tallow Melter.—Please forward your address, as a letter is waiting for you at our office.

E. H. & Co.—You can learn particulars about the automatic steam-boiler feeding apparatus with constant level by writing to M. E. Leroux, 11, Rue des Beaux-Arts, à Paris.

An Old and Regular Subscriber.—Address to M. Théodore Péters, fabricant de couleurs d'aniline et d'orseille, Chemnitz, Saxony.

F. Sutton.—Received, with thanks.

Enquirer.—(1) L. Oertling, 27, Moorgate Street, E.C. (2) None but good ventilation.

M.—See Eggertz's process, given in the Chemical News a short time back.

R. R. Tutlock.—Received, with thanks.

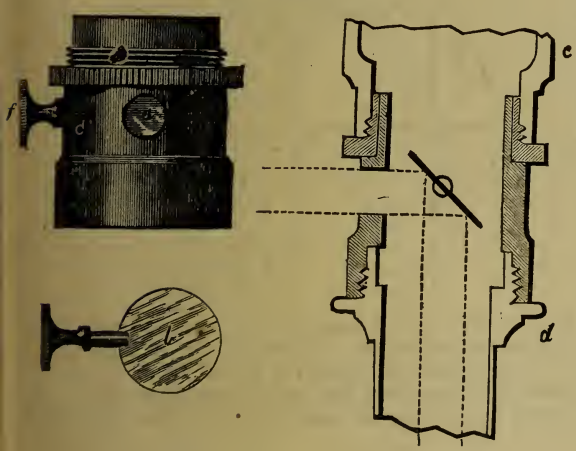
THE CHEMICAL NEWS.
Vol. VI. No. 2. American Reprint.

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

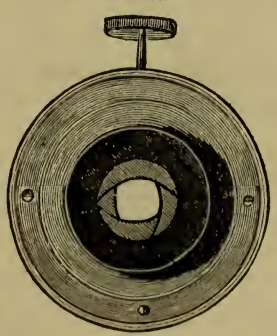
A means of illumination adapted for use with objectives of high power, in which the space above the object is too small to admit of light being thrown upon it by any of the apparatus just described, has been contrived by Professor H. L. Smith, of Kenyon College, Ohio. He uses the object-glass itself as a condenser. A pencil of light is admitted through an aperture in the side of an adapter screwed on to the body of the microscope, which contains a small silvered mirror with suitable adjustments for reflecting the pencil downwards through the object-glass which is attached below the adapter. This apparatus was sent to Mr. E. G. Lobb, of the Royal Microscopical Society, and exhibited at the meeting in January, 1866. The instrument was placed in the hands of Messrs. R. and J. Beck and Messrs. Powell and Lealand, who each produced an improved modification. For the silvered mirror of Professor Smith they both substituted an unsilvered glass surface; that of Messrs. Powell and Lealand was a piece of parallel surfaced glass, fixed at an angle of 45°: Messrs. Beck used a disc of thin cover glass (Fig. 25, *b*), and allowed the angle to be altered at pleasure by means of a milled head, *f*, passing through the aperture, *e*. The light of a lamp is directed through the hole, *a*, in the adapter, and forms an image of the flame on the object when the object-glass is in focus. The lamp should be placed at a distance of about eight inches from the instrument; sometimes a condensing lens may be placed between the lamp and microscope with advantage. The manipulation with the instruments of both makers is precisely similar. The objects to be viewed with this illuminator should be uncovered, otherwise the cover reflects nearly the whole of the light, and scarcely any falls upon the object; some light is also lost by reflection on its passage upwards through the oblique unsilvered mirror. The impossibility of obtaining a satisfactory view of a covered object will most probably prevent this instrument from coming into very general use, although it affords valuable information to those who will take the trouble to master the difficulties attending its use.

Fig. 25.



The second class of illuminators, those which are placed beneath the stage, are also very numerous. The most familiar is the *mirror*, which forms a part of every microscope. A great variety of illumination may be obtained from the mirror alone, if properly mounted so that it may be turned considerably aside. The mirror of many microscopes is now placed on a double-jointed arm, which permits very oblique illumination to be obtained. In order to understand practically the difference caused by the position of the mirror, the student is recommended to examine a diatom of moderate difficulty, such as *Pleurosigma angulatum*, with a good $\frac{1}{4}$ or $\frac{1}{5}$ objective, which should be accurately adjusted for the thickness of the cover glass, and a deep eye-piece should be used. It will be found, when the light is central, that none of the usual markings will be visible; but when the illuminating pencil falls very obliquely, the *apparent* cross lines (?) will come into view. With the better class of microscopes, the mirror is usually made double, one side concave and the other plane; the plane mirror is used for reflecting daylight when the greatest intensity is not required, and for use with the achromatic condenser and parabolic reflector (Wenham's), and in all other cases when parallel rays are needed. The concave mirror acts in some degree as a condenser, and is to be used with lamp light and when it is required to make daylight more intense. The *diaphragm plate* is used in combination with the mirror to regulate the angle of the pencil; this can, however, be done with much greater nicety by employing the graduating diaphragm of Mr. Collins (Fig. 26) or the

Fig. 26.



very beautiful iris diaphragm of Messrs. Beck (Fig. 27),

Fig. 27.

both of which allow the aperture under the stage to be gradually diminished or enlarged without the interval of darkness which occurs during the shifting of the ordinary wheel of diaphragms.

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

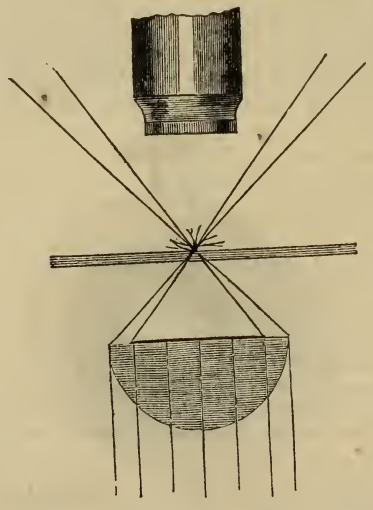
[English Edition, Vol. XX., No. 523, page 265.]

A very useful illumination, resembling the light of a *white cloud*, may be obtained by placing a piece of white paper over the mirror, and concentrating the light of a lamp upon it by means of the condensing lens. The soft white light so produced is extremely pleasant to use, and suits delicate and transparent objects viewed with the binocular, and will be found of more general service than the full light of the mirror, which, with the double body, often produces a most disagreeable glare, which only obscures and confuses instead of defining.

The mirror affords the simplest means of obtaining what is known as *dark field illumination*, for which we are indebted to the Rev. J. B. Reade, F.R.S., President of the Royal Microscopical Society. His original contrivance consisted of an ordinary condensing lens, so placed with respect to the lamp and the stage, that it transmitted a pencil of such obliquity that none of it entered the object-glass, so that the object alone was lighted, while the field remained dark. The same effect can be produced with the mirror when turned very much aside, and only a low power, such as an inch or ⅔ objective, is employed. It is a most valuable mode of illumination, and one which the author employs very extensively, as independently of the beautiful effects produced by it when skilfully managed, it enables structural peculiarities to be observed which are not readily demonstrated by other means.

The black field is still more perfectly obtained by the use of the *spotted lens* (Fig. 28). This consists

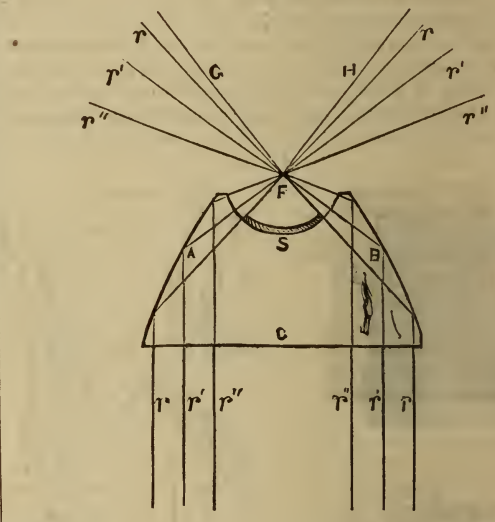
Fig. 28.



of a small bull's-eye, mounted so that it will slide up and down in a fitting beneath the stage to allow of focussing; on the centre of the plane side of the lens is placed an opaque black stop, allowing only the marginal rays to pass. If an object is placed in the focus of the hollow cone of light so transmitted, it will be found, if possessing sufficient opacity, to disperse a portion of the light, to shine brilliantly, and become apparently self-luminous, while, as will be seen by the diagram, the rays, after crossing at the focus, diverge, and do not enter the object-glass, and so leave the field more or less black. The effect is very much that of causing a semitransparent object to appear like an opaque one illuminated by reflected light. *Diatomaceæ*, living aquatic animals and plants, the skeletons of the *Polyzoa*, insect preparations, when not too thin and transparent, and many other objects, are displayed to the greatest advantage by means of black field illumination.

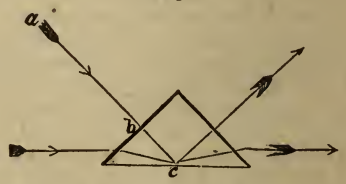
Black field illumination is obtained most perfectly by means of a *paraboloid* placed beneath the stage. Mr. Wenham's first contrivance consisted of a silvered parabolic cup, open at the apex, which reflected parallel rays very obliquely, the access of direct light being prevented by a stop placed in a proper position. The performance of this illuminator was perfect, the only objection to it being that it was rather difficult to keep the reflecting surface bright. This has been remedied by constructing the paraboloid of glass, the illuminator now in use being a solid cast in glass of the original silvered speculum (Fig. 29). It reflects

Fig. 29.



light quite as well as if it were silvered, owing to the law of internal reflection. When a ray of light passing through glass falls upon the surface the angle of which is not less than 38° 41′, it cannot pass out of the glass into air, but is totally reflected (Fig. 30).

Fig. 30.



The ray, *a*, entering the triangular prism at *b*, passes through to *c*, where not being able to pass out into air, it is reflected, as if the surface at *c* were silvered, only far more perfectly, the reflection being total. This principle is made extensive use of in the construction of optical apparatus, a reflecting prism being always preferable when it can be used, on account of its wasting less light than a metallic speculum or silvered glass mirror. If a tumbler is filled with water, and the surface of the water looked at upwards through the side of the glass, it will be

found that the surface of the water will reflect light more brilliantly than the best mirror. The glass paraboloid, although unsilvered, and appearing at first sight to be a lens rather than a mirror, is nevertheless a far more perfect reflector than its metallic predecessor. Parallel rays (Fig. 29, *r*, *r'*, *r''*), falling upon the plane surface, c, at right angles, enter the glass paraboloid without refraction, and not being able to pass out through its curved sides, A, B, are reflected to the focus, F, and diverge from thence at an angle so great that none of them enter the object-glass. The apex is ground out to a spherical figure, so that the pencil also emerges without refraction. The centre stop, S, is attached to a wire passing through a hole drilled in the block of glass, and furnishes a means of adjustment, so that the least oblique rays can be cut off if required, which is necessary when the paraboloid is used with the higher powers, the stop in that case being pushed up as far as it will go. A well constructed paraboloid is capable of giving a black field with a $\frac{1}{6}$th of 100° of aperture. The paraboloid is superior to the spotted lens on account of its freedom from chromatic and spherical aberration, and also from its larger angle, which is about 127°, while the angle of the spotted lens is a little under 90°. The spotted lens, however, can be used with advantage in examining objects which have a degree of transparency which would prevent their perfect observation with the paraboloid, this latter illuminator being better suited for the examination of semi-opaque or translucent tissues. Black field illumination, like that by reflected light, is perhaps more free from the deceptive appearances which so frequently lead to errors of interpretation, and one or both of these modes of lighting should always be employed when practicable. As the amount of light stopped by the object depends in some degree upon its opacity, the relative density of the various parts may be fairly judged of by their respective brilliancy. Dark field illuminators aid very much in the production of stereoscopic effect, no methods of illumination, saving those by reflected light, giving such correct views of the relative position in depth of the various parts of an object, with an advantage peculiar to themselves of revealing internal structure to a great extent.

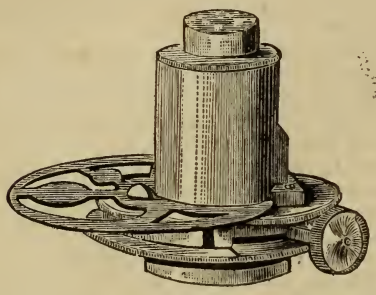
In the old microscopes, constructed before the introduction of the achromatic principle, the want of light was very evident when any but the lowest powers were used; this soon led to the employment of some means of increasing the intensity of the illumination. The usual plan was to place a lens beneath the stage, which acted like a burning-glass, and allowed the light to be increased to almost any extent. When the microscopic object-glass was freed from the chromatic and spherical aberrations, the increase of illumination following the enlargement of its angle of aperture for a time satisfied observers; soon, however, a larger amount of light was, in some cases, found desirable, and it was usual to employ one of the object-glasses (generally the next lowest to the one in use) to concentrate the light upon the object. This simple contrivance is very effective when nothing else but greater intensity is needed, and a foreign $\frac{1}{4}$ object-glass will make a very good combination for this purpose when suitably mounted. For the next improvement, we are indebted to Mr. Gillett, who added a series of diaphragms; these, in the most improved form, comprised some having marginal as well as central apertures, as it was soon found that the direction of the light had a very important influence. The condenser has since undergone many improvements, each of the three leading opticians modifying it to suit the requirements of their respective instruments. It consists, as now made, essentially of a combination of achromatic lenses closely resembling an object-glass, and fitted with one or more diaphragm plates, which, either separately or in combination, give perfect control over the amount of light admitted and its direction; the details of construction vary somewhat in different condensers. This is mounted beneath the stage of the microscope with suitable adjustments for focussing, and also for placing it truly in the axis of the instrument, or centering. As the instrument is difficult for the beginner to use, it is well to give a few directions.

The first care will be to centre the condenser, as the spot of condensed light is extremely small, and should the adjustment not be accurately made, the field of the microscope will be only partially, or not at all, illuminated. The simplest way of centering is to screw on a very low power, and view the setting of the top lens of the condenser; it will then be readily seen whether it occupies the centre of the field, and, should it not do so, the requisite traversing screws are moved until it is found to be accurately in the centre. Or the image of a lamp-flame may be formed with the condenser, and viewed with a moderately-low power, and the screws moved until the image occupies the centre of the field. The focus is then to be adjusted by moving the milled head connected with the proper rack, and a suitable diaphragm turned into place. When the achromatic condenser is used, the flat mirror is to be employed, and if a lamp is the source of light, the rays must be rendered parallel, as before mentioned. Some observers use a prism in the place of a mirror, as it reflects more light, and of a purer quality, than a silvered glass, which gives a reflection from its upper as well as its silvered lower surface, which is likely somewhat to interfere with the perfect illumination of delicate objects. Although the most intense light is obtained when the condenser is accurately in focus, it is sometimes preferable to use the condenser somewhat out of focus; for this, as well as the choice of diaphragms, no particular directions can be given, as much depends upon the nature of the object to be viewed, construction of the instrument, and many other circumstances. A little practice, with the help, if attainable, of an experienced microscopist, will be found the best means of mastering the use of this rather difficult instrument. It is an instructive exercise to place a suitable object upon the stage—a Diatom, for instance—and notice the changes in appearance produced by altering the focus of the condenser and using different diaphragms; so varied are the kinds of marking produced on some of the *Diatomaceæ* by changes of illumination, that it would hardly be believed that the object was the same. It is now tolerably certain that the striæ, or lines, whether single or crossed, and the dots seen on some of these objects, are non-existent, being merely the optical rendering of closely-packed transparent hemispheres. These were observed some years ago by Mr. Wenham, with a 1-50th objective of his own construction, and quite recently by a new and comparatively simple means of illumination discovered by the Rev. J. B. Reade, and described by him in the *Monthly Microscopical Journal* (1869, vol. ii., p. 5). The instrument used is an equilateral triangular prism, which is so adjusted as to reflect an oblique beam of parallel rays. With this illumination, the hemispheres on *Pleurosigma formosum* may be seen with a power so low as a $\frac{2}{3}$, provided the angle of aper-

ture be sufficient. This simple illuminator may probably be of great value for other purposes, besides viewing the surfaces of *Diatomaceæ;* at present, however, it has been so short a time in use, that its full capabilities have not been tested.

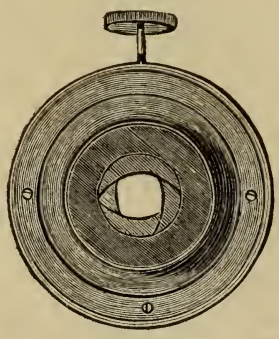
More recently, a condenser, constructed on a different principle, has been introduced, the optical portion closely resembling the Kellner eye-piece, instead of following the usual pattern, which is derived from the object-glass. This condenser (Fig. 31), now well-known as the "Webster," is a most efficient instru-

Fig. 31.*



ment, and, from the simplicity of its construction, is capable of being adapted with advantage to small microscopes. The amount of light given by it is considerable, so great that with the full aperture it is almost more than the eye can bear; this excess of light, if it can be considered as a fault, is certainly a good one, as it permits a very extensive use to be made of diaphragms. The graduating diaphragm (Fig. 32) can be

Fig. 32.*



applied to the Webster condenser with the greatest advantage, and its effect is much more marked than when merely used below the stage to control the illuminating pencil from the mirror. The wheel above the graduating diaphragm consists of a series of central and lateral stops, by the use of which a great variety of oblique and dark field illumination can be obtained; the latter far more efficiently than by the use of the ordinary spotted lens. Recently, a revolving carrier for additional diaphragms has been added to this condenser. It consists of a tube sliding into the lower part of the condenser, and provided at its upper extremity with a contrivance for holding a disc of card or thin brass, in which one or more apertures may be cut. By turning the diaphragm-holder round, the oblique pencil may be directed from any azimuth, and the effect on such objects as the *Diatomaceæ* is very marked indeed, the striæ appearing or disappearing as the aperture is moved to, or away from, the proper angle for bringing them out. This contrivance also allows the observer to try any forms of stop he may consider advantageous, as they may be quickly cut out of a piece of blackened card (B. W. Richardson, *Quarterly Microscopical Journal*, vol. vi., pp. 10, 86). The long focus and large field of the "Webster" render it particularly useful for the general purposes of the student, as it will work into some depth of water, and can be used for illuminating the interior of the troughs so frequently employed in observing living aquatic animals and plants. Although surpassed by the more costly instruments for the most refined description of illumination, it possesses merits peculiarly its own, and no single piece of apparatus can be made to perform so great a variety of offices as this very useful condenser.

The most useful forms of illuminating apparatus have now been described; there are many others, chiefly meant for special purposes—they will be found in the works of Quekett and Carpenter, and the pages of the *Microscopical Quarterly* and *Monthly Journals*, to which the student is referred for descriptions and figures.

In the modes of illumination hitherto described, the light has been made use of in exactly the same condition in which it was received from its source, whether from the sun or a lamp. All that instruments have been required to do has been either to alter its direction or, by concentration, to increase its intensity. It is now proposed to explain a method of conducting microscopical investigations in which the properties of the light have undergone such changes as to produce effects totally different from those of ordinary illumination, and with the result of giving greater insight into the nature of certain structures than could be obtained by other means. The light, in the condition now to be described, is commonly known as *Polarised light.*

With a view to simplify the matter contained in the foregoing papers, no more has been said about the nature and properties of light than was absolutely necessary to enable the action of the apparatus described from time to time to be tolerably well understood. And, although, in the present chapter, far more notice must be taken of the subject, it is by no means intended to give an exhaustive account of the phenomena of polarised light. Space can only be afforded for such an outline as will enable the student to use his apparatus, and observe intelligently. For details, reference must be made to works treating more fully on the subject—such as the chapters on Optics in Mr. Brooke's "Manual of Natural Philosophy," and the various authorities there referred to.

Light, in common with the other forces of nature—heat, electricity in its various forms, dynamic force, &c., —proceeds from its source in a series of undulations or waves, which may be illustrated in a rough manner by throwing a stone into a pond, when the waves will be seen to spread themselves concentrically from the source of motion.

For convenience of explanation, a ray of light in its ordinary condition may be represented in ideal section by a circle (Fig. 33, 1), and undulations supposed to take place in two planes at right angles to each other (C, D and N, S). By means presently to be described, these two sets of waves can be separated, as at 2, C, D and 3, N, S. The ray of light, instead of having the same properties on every side, will be found to have acquired

* For these woodcuts we are indebted to Mr. Collins, of Great Titchfield Street.

some qualities peculiar to the state in which it now is, and which may be named the properties of sides. For instance, 2 will exhibit certain phenomena in the direction C, D which do not exist when it is examined in other directions. The same is the case with the other half of the ray (3), which exhibits similar phenomena in the direction N, S. As these properties somewhat resembled those of the poles of a magnet, the term *polarised light* was used to distinguish light so modified, and, although perhaps not the best name that could have been given, has still been retained.

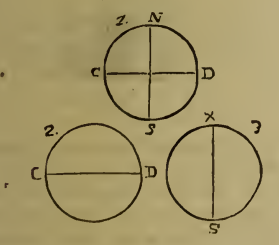
As the phenomena of interference will be frequently mentioned, it will be desirable to state what they are. The sensation affecting the optic nerve which is known as light is caused by the undulations before spoken of—light being represented by motion, darkness by rest.

Should two waves start together from the same place, they would increase each other's intensity; the result would be a wave of double height—a matter easy of comprehension, if water be considered as the medium; with the waves of air producing sound, the result would be a louder sound; and, with light, an illumination of double intensity. Should, however, one wave start before the other by the length of half a wave, the effect would be that the crest of one wave would occupy the position of the hollow of the other, and so fill it up, producing a dead level. The result would be, with water, calm; with air, silence; with light, darkness.

This is known to be the case, in some instances, where the streams from two channels meet in the manner just mentioned: perfectly smooth water is produced, although, before meeting, the surface of both may be violently agitated.

Should the waves of light start at an interval of less than half a wave, they will, by interference, be broken

Fig. 33.*



up into smaller waves, the magnitude of which depends upon the distance one wave has had the start of the other. These small waves produce coloured light, the red wave being the longest, and the violet the shortest. Mr. Woodward gives the following as the lengths of the waves of the various coloured rays of the spectrum:—Red, 266; orange, 240; yellow, 227; green, 211; blue, 196; indigo, 185; violet, 167. The figures represent the numerators of fractions, having as a common denominator the ten-millionth of an inch.

These coloured waves may be produced in various ways; for instance, by very thin plates of transparent substances, such as mica, films of oil or varnish floating on water, and films of air enclosed between transparent solid surfaces, which, by causing a slight difference in the distance of the starting points of the two series of waves of white light reflected from the upper and lower surfaces of the film, sets up interference, and breaks up the waves of white light into smaller coloured ones. The films of varnish were very ingeniously taken up from the surface of water on enamelled cards, by Mr. De la Rue, giving them a beautiful iridescent appearance. Other examples may be found in the feathers of certain birds, as humming birds, peacocks, &c., which possess a metallic lustre produced in the same manner. A minutely grooved surface will also produce similar effects; for example, mother-of-pearl, which consists of a series of thin plates of shell, separated by folds of membrane, producing a grooved structure; also in the finely-ruled gold ornaments known as "Barton's buttons," and the minute specimens of ruling on glass by Nobert, all of which produce brilliant metallic tints by the interference of the two waves reflected, one from the surface, and the other from the bottom of the groove.

If a convex lens of extremely shallow curvature be placed upon a plane glass surface, and an arrangement be provided for exercising delicate and uniform compression, a series of circular concentric coloured bands will be seen; these are known as "Newton's rings," and are caused, as before, by the interference of the reflections from the film of air contained between the lenses; and as, from the curvature of the lens, the film is of a thickness increasing from the centre to the circumference, a variety of tints are formed at every change of thickness, the rings consisting alternately of groups of colour and dark bands, the latter being the places where total interference takes place and darkness or rest is the consequence. These dark spaces are much better seen when the apparatus is viewed by a monochromatic light, such as that produced by the flame of a large spirit-lamp the wick of which has been sprinkled with common table-salt. Not only will the dark bands be sharper and more intense, but they will also be considerably increased in number. These rings may often be seen when plane glass surfaces are unequally compressed; for example, a piece of thin cover-glass pressed on a slide with a stick, and sometimes between the thick plate and glass negative in a photographic printing frame.

The undulatory motion of light would seem to be expressed with considerable clearness in the first chapter of Genesis when read in the original Hebrew, which, in common with the other languages of the same family, is remarkable for the numerous inflexions of its verb, which gives it a delicacy and precision of expression unattainable in Western languages. The first verse concludes:—"And the Spirit of God *moved* upon the face of the waters." This sentence immediately precedes the command that light, which may here be taken in its largest sense, including electricity and the other forces, should exist. The Hebrew word translated "moved" is more accurately expressed by *fluttered;* the same inflexion of the verb is used in this sense in the only other place in which it occurs, viz., Deuteronomy xxxii., 11., where it refers to the fluttering of an eagle over its nest. It is certainly a very remarkable expression, and the author believes that its bearing on the subject of light has hitherto escaped notice. The view that the word "light" includes the other forces, and which we have every reason to believe are but different manifestations of them, is supported by the fact, that sources of light proper or luminaries are not mentioned until the fourteenth verse, while the atmosphere or "firmament" of the English version, land, and water, and vegetable life, were all in existence, and under the influence of these mysterious powers of na-

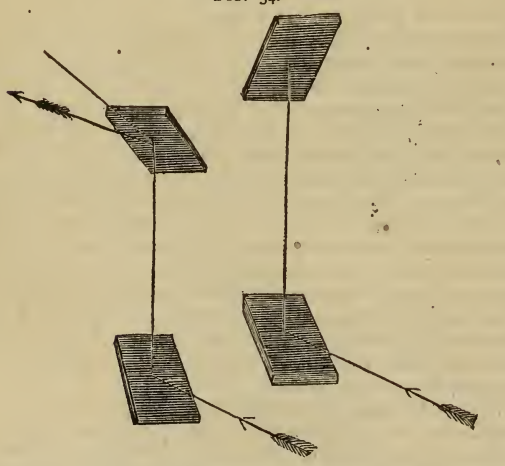
* Brooke's "Natural Philosophy," published by Churchill.

ture, respecting which the undiscovered and unknown probably far exceeds the little that science has at present made us acquainted with.

Light may be polarised in several ways. If a ray of light falls upon glass at an angle of 56° 45′, one-half (Fig. 34) will be transmitted, the other half reflected; and, if, instead of a single plate, about ten sheets of thin window-glass be employed, the result will be much more perfect. The reflection, whether one or more plates be used, will be much improved by either coating the back with black-varnish, or placing in contact with it a piece of black cloth or velvet, which will absorb the transmitted portion of the ray. If the light so reflected be examined by another glass mirror, placed at the same angle, and so mounted that it can be moved horizontally in a circular direction, it will be found that, in some positions, the light will be reflected, while, at others, it will pass through, or be absorbed if the back is blackened. These intervals of reflection and transmission occur alternately at every quarter revolution of the upper mirror or analyser, corresponding with the points in Fig. 33, I, marked C, D and N, S.

If a ray of light be passed through a crystal of Iceland spar, one portion will be refracted according to the

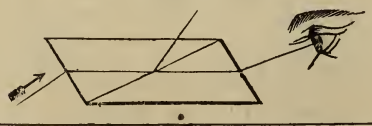
Fig. 34.



usual law; * the other half will be refracted in a different direction. And, if these two rays of light be examined with an analyser, they will be found, as in the case of the reflected light, to have acquired the property of sides, or to be polarised. The ray refracted in the common way is known as the ordinary ray. The other, which is polarised in a plane at right angles to it, is termed the extraordinary ray. If a crystal of Iceland spar be placed on a sheet of paper having a black spot on it, the double refraction will cause the formation of two images of the spot or other device drawn on the paper.

By an ingenious process, invented by Mr. Nicol, a crystal of Iceland spar is divided in the direction indicated in Fig. 35, and joined together again with

Fig. 35.†



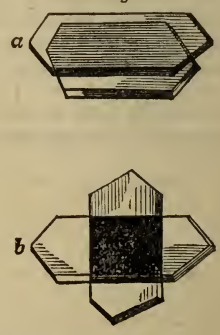
* Chemical News, vol. xx., p. 145; *Am. Repr., Nov.*, 1869, *page* 281.
† Pereira on "Polarised Light," published by Longmans and Co.

Canada balsam. This causes one of the rays to be so much refracted that it is thrown altogether out of view, and only one polarised ray is transmitted. This contrivance is known as the *single image* or *Nicol prism*, and is the means of polarisation most generally adopted for microscopical purposes.

Polarisation may also be effected by the use of thin slices of a mineral known as *tourmaline*. This crystal, when cut into thin plates parallel to the axis of the crystal, allows only the undulations in one plane to pass, the other being stopped. The cause of this action is, as yet, not understood. If two plates of tourmaline are superposed, and held before a strong light, it will be found that the light is alternately transmitted and stopped at every 90°, when one of the plates is rotated.

The same effect is produced, in a much greater degree, by using a pair of crystals of sulphate of iodoquinine, more commonly known as *Herapathite*, from its discoverer, the late Dr. William Bird Herapath. This salt is prepared by a tedious and complicated process, and described in a communication by Dr. Herapath to the Royal Society, and quoted in many microscopical works ("Micrographic Dictionary," second edition, p. 590). The obtaining of large regular crystals fit for polariscopes is a matter of great difficulty; and, unless the student is very expert in chemical manipulation, he is recommended not to attempt it. Small specimens fit for

Fig. 36.



microscopical examination may, however, easily be made. This salt is the most powerful polarising agent known. If two crystals are superposed with their axes parallel (Fig. 36. *a*), light is readily transmitted; but, if the axes are crossed, as in *b*, the parts covering each other become perfectly opaque to transmitted light. This can easily be seen in a slide of the crystals mounted as a microscopical object, as some of the crystals are sure to be in this position.

The sky possesses the power of reflecting polarised light. If the observer stands with one shoulder directed to the sun, so that he faces a point 90° from it, and looks at a white cloud through a Nicol prism, he will find that the light reflected from the cloud is polarised, and that, as the prism is rotated, the cloud will alternately appear as a white cloud on a dark ground and a dark cloud on a light ground.

The effects here described may readily be seen without the special apparatus of mirrors, &c., by any one who has a microscope fitted with the usual polarising apparatus of two Nicol prisms. If the larger one, *the polariser*, be put in its place below the stage, and the mirror so arranged that the light

of a lamp or daylight be directed through it, it will be found, upon rotating the prism in its fitting, that no change is apparent, as the light, although polarised, is transmitted in every position of the prism. If the small prism, or *analyser*,* be now put in its place, either over the object-glass or, better still, over the eye-piece, it will be found that the alternate transmissions and stoppages of light take place. If a film of *selenite* be now placed on the stage of the instrument, it will be found that the light will be coloured; and, when one of the prisms is rotated 90°, the colour will change to the complementary tint. For instance a film that transmits red light in one position of the prisms will transmit a green of such quality as to produce white light, were the two mixed. Blue would produce orange every quarter revolution; and so on through the other tints of the spectrum. Similar effects are produced by using films of mica, and all crystals possessing the property of double refraction.

To understand these changes of colour, it will be necessary to describe the direction of the axes of a crystal of selenite, which is represented in Fig. 37,

Fig. 37.*

A, D and C, B being the position of the depolarising axes, and E, F and C, H that of the optic axes. To understand the powers of these regions of the crystal, it will be necessary to try another experiment, which, although more advantageously shown with a large polariscope, can be done sufficiently well under the microscope. Let the film of selenite be so mounted as to be capable of rotation. If the stage of the microscope is capable of concentric rotation, no further contrivance is necessary. If the prisms now be arranged for the production of colour, and the selenite be slowly rotated, it will be observed that the colour gradually disappears. On continuing the rotation, it increases, and regains its intensity. If the amount of rotation is noticed, it will be found that the disappearances coincide with the position of the optic axes, E, F and G, H, and while the greatest intensity of colour is produced when the plane of polarisation passes through the depolarising axes, A, D and B, C. If the analyser be removed, no colours are to be seen; it is therefore evident that the analyser plays some important part in the production of these colours.

The selenite, being a doubly-refracting crystal, causes the ray of polarised light to be divided into two, which are, as usual, polarised in perpendicular planes, and, reaching the eye together, no colour is produced; but, if the analyser is added to the combination, the colourless image is broken up into two coloured ones, one only of which reaches the eye. If, instead of the Nicol prism, a contrivance known as the "double-image prism" be used, which will transmit both rays, but in a separate condition, the two images of complementary colours will be seen at once, and if, by a suitable contrivance, they be made partially to overlap, the part where they join will be white, produced by the union of the two complementary tints.

The position of the optic axes may be easily observed in the corpuscles of starch and other polariscope objects which produce the well-known black cross, which indicates in a very marked manner the situation of these axes of no polarisation.

The apparatus employed for the examination of microscopical objects by means of polarised light consists of a *polariser*, *analyser*, and *retarding plate*.

The *polariser* is generally a Nicol prism, mounted so that it may be conveniently rotated; this is attached, by a suitable fitting, either beneath the stage, or, in large microscopes, to the sub-stage movement.

The *analyser* varies, being, according to circumstances, a Nicol prism, tourmaline, or Herapathite. The *Nicol prism* is the form of analyser generally used, and can be placed either over the eye-piece or within the body of the microscope above the object-glass; in the first position it has the advantages of being easily rotated, and of not interfering seriously with the definition of the magnified image; but, on the other hand, when used with any eye-pieces but those of the lowest power, it cuts off the margin of the field and reduces it to an injurious extent; this is owing to the prism by its thickness causing the removal of the eye to some distance from the eye-glass, although the Nicol prism, when intended for use as an analyser, is generally made as short as is consistent with efficient action. When the prism is placed within the body, it does not cut off any portion of the field, but the interposition of a dense substance, like Iceland spar, impairs the corrections and consequently the definition of the object-glass, and also causes some loss of light. It is much to be regretted that in many of the smaller microscopes no other provision is made for the placing of the analysing prism. When the binocular is used with polarised light, the analyser can be placed in no other position, and it is usually mounted in a short adapter so contrived that the prism can be easily rotated. It is well to have the means of using the analyser in both positions, that choice can be made of that best adapted to the kind of observation in progress; if very perfect definition is of less consequence than a field of full dimensions, as in viewing such objects as crystals, in which very little detail is to be seen, then the prism in the body may be employed with advantage; but should the formation of an image very perfect in its details be required, then the prism must be placed over the eye-piece.

Tourmaline, when it can be obtained of sufficiently pale colour, makes a good analyser; from its thinness it can be used over deep eye-pieces without cutting off the field; good stones are, however, scarce, and consequently expensive, as many light coloured specimens do not polarise well. The tourmaline is mounted in a brass cap similar to the one placed on the eye-piece, which is to be removed and the analyser substituted. Crystals of *Herapathite* polarise more powerfully, and are much lighter in colour than the palest specimens of tourmaline, and when they can be procured make very perfect analysers; they are extremely thin and do not interfere at all with definition, and are to be preferred in all delicate investigations. Where, however, total

* Brooke's "Natural Philosophy," published by Churchill.

freedom from colour is a necessity, the Nicol prism, notwithstanding its other disadvantages, must be used.

The *retarding plate* or *selenite film* is commonly mounted, either on card, like an ordinary slide, or else in a brass plate, with a ledge to keep the object from slipping off; this is a very disadvantageous form, as the selenite cannot be rotated, while in a perfect polarising arrangement, every part, object included, should be capable of rotation. The most convenient and useful arrangement of selenites is that devised by the late Mr. Darker, in which a series of three discs are by combination made to give as many as thirteen different tints. In large miscroscopes having a substage, these selenites can be mounted so as to be capable of rotation either together or separately, and also allowing the selenites to be used or not, without disturbing the arrangement of the object on the stage.* These advantages have hitherto been confined to large miscroscopes; but Mr. Baily has so mounted a set of Darker's selenites for the author that they can be placed upon the stage in the ordinary manner, and at the same time allow of discs being added or withdrawn and rotated, without interfering with the object; the thickness of this stage plate is no more than is necessary to contain the three discs and allow them space to move, and all complicated machinery is dispensed with. The arrangement of Darker's system of selenites appears, at first sight, somewhat complicated, but is not so in reality, and the power of obtaining such a variety of coloured backgrounds is a very great advantage. The series consists of three discs, marked $\frac{1}{4}$, $\frac{3}{4}$ and $\frac{2}{4}$, which figures represent a certain amount of retarding influence upon the wave of polarised light and consequent colour production. Besides the figures just mentioned, each disc has engraved upon its mounting the mark P.A., meaning positive axis; when the selenites are superposed with these marks coincident, the effect is, that the power of one selenite is added to that of the other; for example, if the $\frac{1}{4}$ and $\frac{3}{4}$ discs are so placed, the power will correspond to the sum of the numbers, viz., $\frac{4}{4}$, but if the $\frac{1}{4}$ be turned round 90° then the $\frac{3}{4}$ will have only a power of $\frac{2}{4}$, the crossed position of the $\frac{1}{4}$ subtracting instead of adding its power to the $\frac{3}{4}$. The experiments with selenite films already described will have prepared the student to understand the cause of this; it will be recollected that the colour disappeared when the selenite passed through one of the optic axes of the selenite, provided the position of the prisms remained the same. If, instead of moving the disc 90° it be only moved 45°, the effect will be to neutralise; instead of giving a negative power the result will be the same as if the selenite were withdrawn. The following table, of the arrangement of Darker's selenites may be useful to those who possess the series. The colours vary somewhat in different sets, so the table must be made out by each observer for his own use. The colours in the following table are those given by Richard Beck in his work on "The Microscope:"—

	Prisms at right angles.	Complementary tint.
1. $\frac{1}{4}$ by itself.....	Very light lavender.	Straw colour.
2. $\frac{3}{4} - \frac{1}{4}$.....	Darker do.	Light yellow.
3. $\frac{3}{4}$ by itself.....	Deep blue.	Light maize.
4. $\frac{3}{4} + \frac{1}{4}$.....	Very light blue.	Orange.
5. $\frac{3}{4} - \frac{2}{4} - \frac{1}{4}$....	Lake.	Emerald green.
6. $\frac{3}{4} - \frac{2}{4}$.....	Deep blue.	Bright yellow.
7. $\frac{3}{4} - \frac{2}{4} + \frac{1}{4}$....	Light green.	Light purple.
8. $\frac{3}{4} - \frac{1}{4}$.....	Light plum colour.	Pea green.
9. $\frac{3}{4}$ by itself.....	Blue green.	Salmon.
10. $\frac{2}{4} + \frac{1}{4}$.....	Green yellow.	Mauve.
11. $\frac{2}{4} + \frac{3}{4} - \frac{1}{4}$...	Pink light.	Green.
12. $\frac{2}{4} + \frac{3}{4}$.....	Light pink.	Deep green.
13. $\frac{2}{4} + \frac{2}{4} + \frac{1}{4}$ ...	Very light red.	Stone green.

(To be continued.)

* A very perfect polarising apparatus is described by Mr. J. J. Field, *Journal of the Quekett Microscopical Club*, vol., p. 215; also in *Monthly Microscopical Journal*, vol. ii., p. 276.

ON THE

CONSTITUTION OF SODIC SULPHATE IN SOLUTION.

BY CHARLES TOMLINSON, F.R.S.

I. Modern Hypotheses.

In the Chemical News (vol. xx. p. 241; *Am. Rep.*, Jan. '70, page 19), you quote, from the *Comptes Rendus* of April 19th, 1869, a note by M. Dubrunfaut, in which he gives credit to M. Löwel for having demonstrated and put in evidence this capital fact—that sodic sulphate, dissolved in water as

$$NaO,SO_3+10HO,$$

is found in solution as NaO,SO_3+7HO. The salt has undergone a molecular change. "We imagine we have dissolved the 10-atom salt; but, in surcharging the solution with an excess of it, we have so modified its composition as to create a new and more soluble compound, capable of producing the strange and mysterious phenomena of supersaturation."

The molecular change which is so clearly made out to this observer is by no means so clear to M. Lecoq de Boisbaudran. In a note to the *Comptes Rendus* of May 3rd, he expresses his opinion that sodic sulphate, in the aqueous solution, is no longer constituted with 7 equivalents of water, any more than with 10, or without any water at all; "but that it may exist under all conditions of hydration, known or unknown, of which the existence is possible. The co-existence of many hydrates in solution is not more difficult of comprehension than the phenomena of dissociation or the equilibrium of ethereal reactions."

In a note in the *Comptes Rendus* for May 10th, M. F. Margueritte denies the justice of M. Dubrunfaut's position as regards the molecular change imputed to alcoholic supersaturated solutions of sugar. He treats the theory as a simple allegation:—"We have hitherto supposed a supersaturated solution to be one in which a liquor dissolves a substance in a proportion which exceeds its normal solubility. The alcoholic solutions of sugar are in this condition; they present the characters of supersaturation, properly so called; and we do not understand the argument of M. Dubrunfaut in opposition to this established fact. . . . As a point of departure, he supposes salts or bodies that present the phenomena of supersaturation to undergo, in dissolving, a modification which augments their solubility; as, when the 10-atom sodic sulphate solution deposits the 7-atom salt, he supposes this to have pre-existed in the solution. In following up this reasoning, we may suppose the salt to exist in three states in the solution, viz., the anhydrous, the 7-atom, and the 10-atom varieties, since we can obtain, at different temperatures, all three. These are simple hypotheses, which cannot resolve the delicate question as to the condition of salts in solution."

On May 24th, a second note appeared from the pen of M. Dubrunfaut. Taking sodic sulphate as the typi-

cal salt for the phenomena of supersaturation, he admits that it offers exceptions to the general laws which regulate solubility as a function of the temperature. The investigation is difficult, because the state of supersaturation can be maintained only in close vessels, so that, in seeking to apply physical tests, crystallisation sets in, and the state of supersaturation is at an end. Moreover, these solutions are not obedient to the test of optical rotation. Hence, in interpreting Löwel's hypothesis, M. Lecoq de Boisbaudran has not a more solid standpoint than M. Dubrunfaut. But there can be no doubt that sodic sulphate, in the condition of supersaturation, has lost its primary constitution as a 10-atom salt, since its solubility has increased tenfold at 0° C. It owes this modification to the influence of the water, though heat may regulate the exertion of it.

Now, the 10-atom salt, at 18° C., gives at once, to water, a density of 1120, water being 1000. This is the density of the normal saturated solution.

The mother liquor of a solution saturated at 103°, which, after being supersaturated, is made to deposit the normal salt by disturbing the state of supersaturation, has also a density of about 1120 at 18°. The mother liquor of the crystals formed after saturation at 33° has a similar density.

If the anhydrous salt formed by drying the 10-atom salt be treated with water at 18°, the initial density of the solution is 1157, which, after five or six hours' contact with excess of the salt, rises to 1167. It then falls, and after twenty-four hours, it becomes 1120 at 18°.

The anhydrous salt vitrified by fusion appears to be a little more soluble under the same conditions, since the initial density of the solution, which is 1167, attains the maximum of 1180, but, in twenty-four hours, falls to 1120.

The 7-atom salt cannot, of course, be operated on; but it is known to be less soluble than the anhydrous, and the density of its mother liquor is 1120.

Hence there is only one fixed term of solubility, namely, that given by the 10-atom salt, and represented by 1120 at 18° C. Whatever modifications are produced in the solutions by means of temperature or supersaturation, the mother liquor always returns, after the lapse of sufficient time, to this normal, fixed density of 1120.

In considering the abnormal solubility of the anhydrous salt, whether obtained by drying or fusing the 10-atom variety, and in comparing the amorphous state of this salt with sugars in the state of supersaturation, are we not led to conclude that the molecular constitution of the anhydrous sulphate has the same constitution as that of the sugars in supersaturated solutions?

The depression in temperature which accompanies solution implies a transfer of heat into molecular mechanical work under the conditions of supersaturation. When this state ceases, the temperature rises, implying an inverse transfer of mechanical work into heat, in consequence of the return of the saline molecule to its primary constitution.

The facts of superfusion and supersaturation are well explained by changes in physical and chemical constitution brought about by fusion or solution, the two molecular conditions being, probably, the crystalline and the amorphous.

Such are M. Dubrunfaut's views, which I have endeavoured to give in a condensed form. M. Margueritte replied, on June 7th, that M. Dubrunfaut's hypotheses are contradicted by experiment. Crystallised sugar may form supersaturated solutions in dilute alcohol, and still preserve intact its optical properties, and, therefore, the identity of its constitution, a fact which proves that the increased transitory solubility of a body is not the effect of a molecular change or of an isomeric modification.

The same number of the *Comptes Rendus* contains also a note by M. Lecoq de Boisbaudran, in reply to M. Dubrunfaut. After some remarks on change of structure by means of fusion, which produces modifications similar to those which result from solution, he admits that Löwel's hypothesis rests on facts observed under conditions when supersaturation no longer exists. While not agreeing with M. Dubrunfaut, he does not insist on his own hypothesis; and, although optical tests fail in the case of sodic sulphate, yet an experiment with chrome alum shows the co-existence of two different modifications in a definite state of solution. Dissolve chrome alum in the cold, and the solution has a blue-violet colour; dissolve the same salt in boiling water, and the solution is dark green. If the two solutions be exposed to the ordinary temperature, the blue solution soon loses a little of its purity, and tends to become greenish, while the green solution tends to become bluish, until at length the two solutions pass into the same green-blue colour, which represents the intermediate state between the initial modifications.

M. Lecoq de Boisbaudran cannot understand M. Dubrunfaut's object in undertaking new experiments on the density of the mother liquors of sodic sulphate, since it has long been known that, by exposure to the air, the 10-atom salt is produced from the various solutions, and that, under like conditions of temperature and saturation, the densities must be equal. If M. Dubrunfaut had operated on the anhydrous salt without exposure to the dust of the air, he would have obtained a stronger mother liquor. When a supersaturated solution resting on an excess of the anhydrous salt is suddenly solidified by contact with a crystal of the 10-atom salt, the mother liquor of the anhydrous salt is much richer than the mother liquor of the 10-atom crystals. He believes the solubilities of all three varieties of the same salt to be equally normal. The solubility of a body ought to be definite under determined physical conditions (temperature, pressure, &c.); but, if such body is in the presence of one of its more stable modifications, this will destroy the initial modification, and we should certainly fall into error in attributing to the primitive body the observed solubility.

M. Dubrunfaut, abandoning the hypothesis which supposes the 10-atom sodic sulphate to exist as the 7-atom in solution, now supposes the anhydrous salt to be in solution. The objections to the opinion that only the 7-atom salt is in solution apply with even more force to the new proposal to make the anhydrous salt play the same part.

Such is the state of the question at the present time among the French chemists whose views are reported by the Academy. The favourite view of supersaturation, both in French as well as English, American, and, I may add, German text-books, is Löwel's—namely, that a solution (say of sodic sulphate) saturated at a high temperature, and left to cool in a close or loosely covered vessel, does not actually become supersaturated, but undergoes a molecular change, in which the 10-atom salt becomes the more soluble 7-atom; so that, instead of having a supersaturated solution of the 10-atom salt, we have only a saturated solution of the 7-atom. When, however, under the influence of some mysterious catalytic action, crystallisation is about to set in, the solution suddenly recovers the

molecular constitution of the 10-atom salt, as well as its solubility, and the 10-atom salt is thrown down.

All this is very ingenious. The most remarkable circumstance connected with the Löwel hypothesis is that Löwel was himself the first chemist who called it in question. The facts are these:—Löwel's first memoir appeared in 1850; his fifth in 1855; in all of which he maintains the molecular theory above stated in the case of sodic sulphate, and a similar theory with respect to two other salts—viz., the sodic carbonate and the magnesia sulphate. But, in 1857, he published a sixth memoir, in which he strongly inclines to the opinion that, within the limits of a considerable range of temperature, sodic sulphate in solution is in the anhydrous condition. His views will be given in another article.

II.—Löwel's Hypothesis—Another Hypothesis.

As there is no harder or pleasanter intellectual work than original research, so there is no harder or more unpleasant moral work than having to modify or reconstruct one's own theory after having spent years of toil in establishing it, and even after it has been accepted with applause by competent critics. This is what M. Löwel has done; and I cannot sufficiently honour and respect him for his candour in having been the first to awake to the sense of his own defects, and to wind up his work by saying so.

As already stated, his first five memoirs were published between 1850 and 1855. In his sixth and last memoir, published in 1857, he is led, chiefly by three considerations, to suppose that, between the boiling point of a saturated solution of sodic sulphate (103·17° C.) and the point when the 7-atom salt begins to be deposited (18°), it is not this modified salt, but the anhydrous variety, that is held in solution. His reasons are the following:—

1. That the 10-atom salt parts so readily with its water of crystallisation by mere exposure to the air at temperatures between 15° and 20° C.

2. That Faraday found, on evaporating a solution of the 10-atom salt below 100° C. (or, according to Mitscherlich, below 40°), the anhydrous salt was deposited.

3. That, in boiling for some time a saturated solution of the 10-atom salt, small, hard, granular crystals of the anhydrous salt are formed as the solution becomes concentrated.

But M. Löwel cannot get rid altogether of his molecular theory. Although he admits that, between the boiling point of a saturated solution (103·17°C.) and the point when the modified salt begins to be formed (18°), the anhydrous salt is held in solution, yet, at and below 18°, a molecular change comes over the solution, by virtue of which it holds or begins to deposit the 7-atom salt.

In weaker solutions, it is admitted that this molecular change takes place at yet lower temperatures. A boiling solution of 2 parts of the 10-atom salt to 1 part of water, for example, must be cooled to 7° or 8° C. before it deposits the modified salt; while a solution of 1 part salt to 1 part of water must be reduced to 0° before the 7-atom salt is deposited. Hence the 7-atom salt is not deposited at the same temperature, but at very different temperatures, low in proportion as there are fewer saline molecules in solution. He admits that it was an error to suppose the 7-atom salt to be already formed, since such solutions do not begin to deposit the modified salt as soon as the temperature passes below the point at which the solutions would be saturated with that salt if it were really present. Thus the boiling saturated solution would be saturated with the 7-atom salt at about 26° C., and it did not begin to deposit that salt under 17° or 18°. The weaker solution (2 salt to 1 water) would, in like manner, be saturated at 18°; but it was reduced to 8° before the 7-atom salt appeared; while the still weaker solution (1 salt to 1 water) required a reduction of temperature equal to 0°. The first solution evidently contained anhydrous salt up to the very moment when it began to deposit the 7-atom salt; and there is no reason to suppose the other two solutions, although much less rich in salt, to have been differently constituted. Moreover, when the second solution has deposited the 7-atom salt at 7° or 8°, so long as it remains in contact with these crystals, it possesses fixed points or terms of saturation, limited by the temperature—that is, it deposits the 7-atom salt when its temperature is reduced, and it re-dissolves it to saturation when the temperature rises; but, if this elevation of temperature reach to 22° or 24°, so that the 7-atom salt is totally dissolved, the solution will not deposit crystals when the temperature again falls a little below 18°, but it must be lowered to 8° or 7°, just as if it had not deposited salt at all. "Hence," he says, "I conclude that the 10-atom salt, as well as the 7-atom salt, in passing into solution, at whatever temperature, gives up the whole of its water of crystallization. Under what conditions, then, are these salts in solution? I can only give hypotheses; and, without seeking to define this condition, it may be best to say that, in passing into solution, they assume an indeterminate molecular constitution, which may be termed the molecular constitution of sulphate of soda in solution, which differs from the molecular constitution of the crystals of the 10-atom, the 7-atom, and the anhydrous salt."

Löwel has given very full tables of the solubility of each of the three forms of sodic sulphate at various temperatures, and his determinations extend to two places of decimals. "I could not," he says, "determine the point of maximum solubility of the anhydrous salt at temperatures below which it begins to deposit the 7-atom salt. At 18°, the change of state is made suddenly; the solutions become troubled, and deposit crystals of the 7-atom salt in a pulverulent form."

Here I venture to think M. Löwel missed his opportunity. If, instead of depositing "crystals of the 7-atom salt," he could have written, "the anhydrous salt," he would have saved himself from much embarrassment, and the present discussion would have been unnecessary.

It was in repeating some of M. Löwel's experiments during the cold weather of December, 1867, that I observed the sudden troubling of the solution. A stream of nearly ice-cold water was allowed to run upon a flask containing a warm supersaturated solution of sodic sulphate, when it suddenly became opaque, from the formation of a multitude of minute crystals, which seemed to increase in number on gently shaking the flask. On repeating the experiment with more care with solutions in test-tubes placed in transparent freezing mixtures, these crystals were soon recognised as the octohedra of the anhydrous salt. I will quote from my note-book a few out of many of the experiments that were made to determine what seemed to me to be a very important point; for it was this experiment that first led me to question the integrity of the molecular theory, as well as the reality of the so-called catalytic action of the sides of the flasks and of solid nuclei.

A solution of 3 parts of the 10-atom salt to 1 part of distilled water was boiled at 218° F., when a small portion of anhydrous salt was thrown down. The solu-

tion was filtered into a flask, in which it was again boiled. The flask was then plugged, with a thermometer passing through the plug. When the solution had cooled down to the temperature of the room, the flask was put into cold water. At 54°, a few well-shaped, sharply-cut octohedra began to fall. At 50°, the number of crystals had so greatly increased as to render the solution opaque; heat currents were liberated, and the temperature rose to 58°.

Two parts of the 10-atom salt to 1 part water: octohedral crystals began to form at 48°.

One part salt to 1 of water: at 35°, a few well-shaped octohedral crystals were thrown down.

So far, then, it seemed to me to be perfectly well made out that the 10-atom salt, in passing into solution, gives up the whole of its water of crystallisation to the solvent. In heating the solutions, a dendritic crystallisation of the anhydrous salt creeps up the side of the flask just above the level of the solution; and, in filtering strong solutions, a thin anhydrous crust forms on the surface of the liquid in the filter. The proofs are manifold that the anhydrous salt is in solution; but the most convincing proof of the fact seems to me to be the throwing down of anhydrous crystals on lowering the temperature of the solutions to a sufficient degree.

The abrupt change that takes place in the curve of solubility of the 10-atom salt at 33° or 34° C. was pointed out by Gay Lussac, and explained by him that, whereas it is the saline molecule $NaO,SO_3 + 10Aq.$ that enters into solution, yet, beyond this point, when the solubility diminishes up to boiling, it is the anhydrous salt that is in solution.

Löwel remarks on this:—"We can easily explain why the solubility of sulphate of soda presents this curious anomaly of increasing with the temperature up to a certain maximum, and then diminishing as the temperature rises. So long as the salt is in the form of 10-atom crystals, its solubility increases from 0° to 34° C. Above 34° this salt no longer exists; it becomes anhydrous, with a different molecular constitution and solubility. The solubility of the anhydrous salt follows an inverse order as compared with that of the 10-atom hydrate. It diminishes in proportion as the temperature rises, or, what is the same thing, it increases as the temperature falls from 103·17° (the boiling point of a saturated solution), not only to 34°, but also to 18° and 17°, when the dissolved salt undergoes a new modification in its molecular constitution, and begins to form crystals of the 7-atom hydrate."

Now, if it be true that the 10-atom hydrate remains in solution up to 34° C. (93·2 F.), solutions made below that temperature ought to deposit the 10-atom salt on cooling in close vessels, just as they do in open vessels where they are in contact with nuclei; but the fact is, such solutions still deposit the anhydrous salt. Solutions saturated at about 85°, or from that to 88° F., and filtered into flasks warmed to that point, and then plugged, were kept until the next day, without any deposit of salt. On detaining them for some time in a freezing mixture, at from 16° to 25° F., they sometimes froze, but, on several occasions, they threw down small, well-defined crystals of the anhydrous salt. Hence, it cannot be true that, up to 34° C., it is the 10-atom salt that is held in solution.

There remains still one point to be discussed. M. Löwel supposes that the supersaturated solutions, in cooling to 18° or 17° C. (64·4 to 62·6 F.), assume the molecular constitution of the 7-atom hydrate; and, further, that, when this salt is deposited, the non-crystallised portion of the solution is the mother liquor of the 7-atom salt. He determines the solubility of this 7-atom hydrate by carefully withdrawing, by means of a warm pipette, a little of the so-called mother liquor at a known temperature, weighing it, evaporating it to dryness, and so calculating the solubility of the 7-atom salt in terms of the anhydrous salt obtained by the evaporation.

But, suppose the so-called mother liquor resting on crystals of the 7-atom salt is once more a solution of the anhydrous salt, what then becomes of the table of solubilities? and what of the theory of molecular change at 17° or 18° C.?

I made a solution of about 2½ parts of the 10-atom hydrate in one part of water; boiled it, and filtered it into three test-tubes, which were then plugged with cotton-wool, and placed upright in a rack close to the window to cool. They were then put into water at from 35° to 40° F., when octohedral crystals of the anhydrous salt were deposited in all three solutions. The tubes were now returned to the rack, when, in a few hours, the 7-atom salt was formed, a few prisms with oblique summits being well marked. The tubes were now put into a freezing mixture, at 20° F., when another shower of beautiful octohedra took place. I need hardly say that, if the molecular change insisted on by M. Löwel had taken place, and if the solution resting on the 7-atom hydrate had been its mother liquor, crystals of the 7-atom hydrate must have been thrown down, and not those of the anhydrous salt.

The tubes were again returned to the rack; when, after some time, another formation of the 7-atom hydrate took place. Next day, in order to be quite sure that it was the 7-atom salt at the bottom of the tubes, the cotton-wool plug was removed from one of them, when crystallisation of the 10-atom salt at once set in from the surface, and, proceeding downwards, converted the deposit into an opaque, chalky mass, or, as Ziz says, "like boiled white of egg," the crystallisation above it being translucent, like ground glass. The two remaining tubes were put into a freezing mixture at about 10° F. The crystals were long in coming, but at length a few well-defined octohedra fell down from the solution in each tube.

I remember that Professor Daniell, of King's College, was in the habit of introducing the same experiment, under different forms, even to variations in the shape of a bottle or flask, in order that his pupils might be allured by the principle involved, rather than by the form of the apparatus. Profiting by this useful example, I prepared a solution of about 4 salt to 1 water, in flasks, where, with much less depth, there was a greater body of solution than in the tubes. The flasks were exposed to the cold of the window-ledge, where they remained all night. Next morning there was a copious deposit of the 7-atom salt. On putting one of the flasks into a freezing mixture, at 25°, F., there was an abundant liberation of anhydrous crystals from the so-called mother liquor of the 7-atom salt, but which is really a solution of the anhydrous salt.

I ought, perhaps, to apologise for drawing thus freely on my note-books for these experiments. My best excuse is that they have not been previously published. In my memoir on "Supersaturated Saline Solutions," I was satisfied with the statement, accompanied by one experiment only, that solutions of Glauber's salt, when removed from the influence of nuclei, hold anhydrous salt in solution, and deposit it

on a proper reduction of temperature. Such was my conclusion two years ago; and I see no reason to alter my opinion now. On the contrary, that opinion is strengthened by experience, and by recurring to Professor Daniell's favourite process of varying and multiplying the means, so as to become more secure of the end. One such variation I cannot help giving, since it leads to the same conclusion, by means of a physical test of great practical value.

In the experiments for determining the elasticity of steam from pure water, the elasticity is diminished for any given temperature, if a small portion of a salt, such as soda, soluble in water and not capable of rising in vapour with it, be allowed to ascend to the top of the mercurial column, the column rises, thereby indicating a diminished elasticity of the steam. The adhesion of the soda to the water tends to restrain the water from evaporating, and this tendency is a measurable force, and here measured; for it partly balances the tension of the water, or its tendency to emit steam, and thus makes the steam-emitting tension of a solution of soda measurably less than that of pure water at the same temperature.

Now, it is clear that, if, instead of soda, Glauber's salt be used in experiments of this kind, there would be a smaller amount of diminution in the elasticity of the steam if the salt in solution retained its water of crystallisation than if it entered into solution in the anhydrous form. In a valuable series of experiments by Wüllner,* it appears to have been established that, for solutions of various strengths (such as 10, 20, 30, &c. per cent of Glauber's salt in pure water), and at various temperatures, from 10° to 100° C., the diminution in the elasticity of the steam is proportional to the quantity of *dry* salt in solution; and, further, that, at the point of maximum solubility of this salt, no molecular change takes place, or it would have impressed itself on the curve which represents the elasticity of the steam. The general conclusion for the salts tried is that the action of efflorescent salts is expressed in terms of the dry salt, while, for deliquescent salts, it is in terms of the hydrated salt.

I cannot wind up without entering a protest against the doctrine involved in the foot-note to M. Dubrunfaut's paper (Chemical News, vol. xx., p. 241; *Am. Repr., Jan.*, '70, page 19). which amounts to this—that, if a man repeat the published experiments of others without knowing it, he is entitled to claim the results as original discoveries of his own. I am quite aware that credit is given to M. Löwel in our text-books for discoveries that belong to previous inquirers; and, with all due respect for him, I cannot help thinking that he would have improved his work by quoting his authorities more freely. Now, at the time when Löwel commenced his labours, a large number of well-attested facts had been established by such men as Ziz, Ogden, Faraday, Turner, Graham and others. Löwel does refer incidentally to Ziz and Faraday, proving that he knew something of their results; and yet we are now coolly told that all those honored names are to be swept away, and Löwel only referred to as the discoverer of the leading phenomena of supersaturation. If such reasoning and practice were applied in literature as they are on some occasions in science and the useful arts, we should realise the condition of the modern epic poet, who declared that he had splendid thoughts, only those scoundrels, the Ancients, had already appropriated them.

Highgate, N., November 24th, 1869.

* *Pogg. Ann.*, cliii., 529, and cx, 564.

ON THE

COMBINATIONS OF PHOSPHATE OF LIME AND SULPHUROUS ACID.*

BY DR. B. W. GERLAND, MACCLESFIELD.

Phosphate of lime, in whatever state it may be, readily dissolves in an aqueous solution of sulphurous acid. The solution can be obtained of great strength; thus, from freshly precipitated tribasic phosphate of lime, a liquor was prepared of 1·3 specific gravity; and, from bone-ash, one of 1·1708 specific gravity. The former contained, in 1000 c. c.—

	grms.
Sulphurous acid	218·38
Sulphuric acid	0·70
Lime	101·79
Phosphoric acid	82·89
	403·76

These figures agree tolerably with the formula—

$$3CaO,PO_5 + 6SO_2,$$

as the comparison with the calculated table shows—

$3CaO$	84	98·20
PO_5	71·4	82·89
$6SO_2$	192	224·45
		405·54

The solution of bone-ash, in sulphurous acid of 1·1708 specific gravity, was found to contain, in 1000 c.c.—

	grms.
Sulphurous acid	141·82
Sulphuric acid	trace
Phosphoric acid	47·42
Magnesia	2·79
Lime	59·69
	251·72

The formula $3CaO,PO_5,6SO_2$ requires, for 47.42 PO_5—

	grms.	
Lime	55·78	
Phosphoric acid	47·42	
Sulphurous acid	127·50	
		230·70
The excess of lime in the analysis is		3·91
and magnesia		2·79
These two would require sulphurous acid		8·73
Excess of sulphurous acid		5·58
		251·71

The bone-ash which was left undissolved by the sulphurous acid had lost all its magnesia, a circumstance which accounts for the large amount of magnesia in the liquor.

The proportion of $3CaO,PO_5$ and SO_2 varies according to the strength of the liquor; if the latter is, for instance, 1·060 specific gravity, 5eq SO_2 dissolve $3CaO$, PO_5; and, in still weaker solutions, we find only 4eq SO_2 for $3CaO,PO_5$.

These solutions possess very interesting reactions, some of which are the following.

A neutral solution of ferric chloride precipitates straw-coloured phosphate of iron, and, if added in proper quantity, the liquor is free from both iron and phosphoric acid. The precipitate, after washing and drying over sulphuric acid, is free from lime and sulphurous acid. Its analysis agrees well with the formula $Fe_2O_3,PO_5 + 5HO$.

* Read before the Manchester Literary and Philosophical Society Nov. 16th, 1869.

Acetate of copper colours the sulphurous acid solution, when added in small quantity, intensely green; a further addition produces a thick yellow precipitate, which rapidly changes in contact with air, and thereby becomes green. Acetate of lead also produces a thick precipitate of white colour. These precipitates contain, besides the metallic oxide, lime, phosphoric and sulphurous acids. Chloride of barium precipitates the solution directly, and chloride of magnesium after some standing.

The solution of phosphate of lime in sulphurous acid possesses the taste and smell of the acid, but to a much smaller extent than an aqueous solution of the acid containing the same amount of sulphurous acid.

Under the influence of boiling heat, the phosphate solution is decomposed slowly, sulphurous acid escapes, and a heavy white crystalline precipitate is formed. Under the microscope, it appears as composed of crystals of the hexagonal system, like those of rock-crystal. Washed and dried over sulphuric acid, it contained—

Sulphurous acid	15·61
Sulphuric acid	0·23
Lime	39·89
Phosphoric acid	34·48
Water	9·08
	99·29

These numbers agree with the formula—

$$3CaO,PO_5,SO_2,2HO,$$

the calculated numbers of which are—

SO_2	32	15·58
$3CaO$	84	40·89
PO_5	71·4	34·76
$2HO$	18	8·77
	205·4	100·00

This sulphited phosphate of lime has no smell or taste, and is distinguished from all sulphites by its stability. Heated in an air-bath for three hours to 130° C., it lost 0·64 per cent of water; but the amount of sulphurous acid remained unchanged, neither had a humid atmosphere the slightest effect upon it. The water is held in intimate combination, and is only expelled at a higher temperature when it is accompanied by fumes of sulphur, sulphuric and sulphurous acids. The residue contains, besides lime and phosphoric acid, sulphate and sulphide of calcium.

Cold water has no effect upon the sulphited phosphate of lime. After long-continued boiling, the air being excluded, a partial decomposition takes place, which is shown by the following analysis.

1000 c.c. of the water contained—

	grm.
SO_2	0·2680
SO_3	0·0470
PO_5	0·1181
CaO	0·2045

And an undetermined quantity of the undissolved residue contained—

SO_2	0·03464
PO_5	0·12393
CaO	0·13916

The constituents are, therefore, in the following proportions:

In the solution—

1 eq. PO_5 : 4·35 eq. CaO : 5·07 eq. SO_2 : 0·71 eq. SO_3;

And in the residue—

1 eq. PO_5 : 2·85 eq. CaO : 0·623 eq. SO_2.

The sulphite, which withstands the action of the atmosphere indefinitely, is rapidly oxidised when incorporated with soil. A quantity was buried in a heavy clay soil (which, as was ascertained previously, contained no lime and phosphoric acid soluble in dilute hydrochloric acid), and was exhumed after two months, when it was found to be free from sulphurous acid. The sample was selected for analysis with the least possible quantity of soil. It contained—

	per cent.
SO_3	18·59
PO_5	24·58
CaO	33·66

The oxidising process which has taken place in this instance may be expressed by the formula—

$$3CaO,PO_5,SO_2,2HO + O = 2CaO,HO,PO_5 + CaO,SO_3 + HO.$$

The original substance contained 34·5 per cent PO_5 and 15·8 per cent sulphurous acid, equal to 19·75 per cent SO_3. The sample for the last analysis ought, therefore, to contain, for 24·58 per cent PO_5, 14 per cent SO_3; but, according to the analysis, it contains 18·59 per cent—that is, 4½ per cent more. This excess of sulphuric acid proves that it is dissolved at a slower rate than the phosphoric acid. Calculating the amount of lime which the acids of the analysis require, we find, for—

18·59 SO_3 as CaO,SO_3	13·01	per cent CaO,
And for—		
24·58 per cent PO_5 as $2CaO,PO_5$	19·28	" "
Total	32·29	"

This number is less than the quantity of CaO found by 1·37 per cent, which excess is to be accounted for by the tendencies of the dibasic phosphate to undergo a partial decomposition under the action of water, in consequence of which a compound of higher basicity is left undissolved.

It is, therefore, evident that the new compound will, in the soil, act as a soluble phosphate of lime; it has, in fact, for several seasons been used as a manure, and has given great satisfaction.

Strong mineral acids dissolve the sulphited phosphate of lime under effervescence of sulphurous acid. Acetic acid has no effect in the cold, and dissolves it only after long-continued boiling, but much easier when the air has access. Oxalic acid decomposes it a little quicker. Chlorine gas is readily absorbed by the new phosphate. After the action is completed, it contains no more sulphurous acid, but only traces of sulphuric acid. Of the phosphoric acid, only a small portion has become soluble (about 1–12th). This decomposition still occupies my attention.

A weak solution of iodine, such as Mohr's standard solution, acts readily upon the sulphited phosphate of lime, as represented by the formula—

$$3CaO,PO_5,SO_2,2HO + I = CaO,2HO,PO_5 + CaO,SO_3 + CaI.$$

The colour of the iodine disappears as long as there is substance left undissolved. This is a convenient method for estimating the sulphurous acid of the compound; but, as the last portions are only slowly acted upon by the iodine, it is advisable, in order to save time, to add a drop of hydrochloric acid, when the iodine begins to disappear slowly: it does not interfere with the accuracy of the experiment.

The sulphited phosphate of lime, exposed to an atmosphere containing ammonia, rapidly absorbs the latter, but, at the same time, an equivalent quantity of sulphurous acid seems to be oxidised. A sample of the

substance was placed under a glass shade with pieces of carbonate of ammonia and water for four weeks, and subsequently over sulphuric acid for two days, and yielded, by analysis, the following results :—

	per cent.
Lime	39·08
Sulphurous acid	2·50
Ammonia	5·60

The new sulphite possesses remarkable antiseptic and disinfecting powers, and, on this account, will command a general interest. The efficacy of sulphurous acid as a disinfectant is well known, and it would be more appreciated if it could be conveniently applied. The aqueous solution is expensive by transport; it is very changeable, and, in many cases, it is unavailable, on account of its pungent smell, whilst, for medical purposes, it can only be used in exceptional cases, in consequence of its irritating action. The sulphites are still more changeable. Exposed to the air, they are acted upon by carbonic acid and by oxygen; and, when mixed with decaying organic matter for disinfecting purposes, they very often increase the mischief, and sometimes cause an abundant escape of sulphuretted hydrogen. The compound of phosphate of lime with sulphurous acid has none of these disadvantages. Acids, as well as ammonia, are neutralised by it. From a sanitary point of view, ammonia is particularly objectionable: being a product of putridity, it helps to accelerate it, and also serves as a vehicle for disseminating other products which, without it, would not be volatile, or only so to a less degree.

The sulphited phosphate, when applied to putrid matter, will probably do its first service by neutralising the ammonia present (including compound ammonias), and also prevent its further formation, as the test-paper will show. The smell will soon cease, or, at least, be greatly diminished and altered, and the mass will be safe for a long time, so that it may be removed or dried without danger or inconvenience. I must here remark that large quantities of putrid matter in open spaces are more completely and speedily disinfected by small portions of the phosphate than samples in glass bottles. The compound recommends itself as a disinfectant by its physical properties. It is a clean white powder, which stains and soils nothing, dusts off garments or carpets, leaving no mark; it is free from smell and taste, and harmless to animal life.

It proves itself invaluable in stables and shippons. The air of these localities is generally highly charged with ammonia, yet the tenants are expected to live and thrive. A regular application of a small quantity of the phosphate will prevent the loss of ammonia, it will sweeten the air, and enrich the manure with phosphoric acid, thus being of threefold advantage. The loss of ammonia from the dung is not inconsiderable; it is also the most valuable constituent of it, being worth more than 9d. per lb. to the farmer.

The solution of phosphate of lime in sulphurous acid also possesses disinfecting powers, and acts, in many cases, even with greater energy than the powder. It might be used with advantage as being applicable to places which could not be reached by the other.

The neutrality, regularity of composition, utter harmlessness, and freedom from smell and taste, recommend the sulphited phosphate of lime for trial in therapeutics. It would be of interest to investigate it in relation to putrid puerperal fevers, pyæmia, &c.

It appeared to me not unlikely that a compound of phosphate of lime with 2 eq. sulphurous acid might exist. Numerous experiments, made with a view of preparing the same, have entirely failed; but some of the results are interesting as showing unexpected reactions of these compounds.

The sulphite of phosphate of lime is not acted upon by the solution of phosphate of lime in sulphurous acid. Sulphurous acid gas is only absorbed in very small proportion by either dry or wet bone-ash. This phosphate of lime is not even converted into the sulphurous acid compound by digestion with the sulphurous acid solution. If sulphurous gas is passed through water holding an excess of phosphate of lime in suspension, the latter remains unchanged.

Under the receiver of an air-pump, the sulphurous acid solution forms good sized crystals, probably belonging to the hexagonal system. Analyses of crystals of different preparations gave varying results, which, however, agreed tolerably with the formula—

$$x(3CaO,PO_5,SO_2,2HO)+y(CaO,SO^3,2HO)+z(CaO,SO^2+5HO).$$

The more crystals separate from the solution, the more the phosphoric acid accumulates in the latter. In one instance, lime, phosphoric acid, and sulphurous acid were almost in proportion of their equivalents.

Alcohol precipitates the solution of phosphate of lime in sulphurous acid. The analysis of the precipitate gave 24·8 per cent of water, and no more sulphurous acid, in proportion to lime, than the above-described powder.

The solution is also precipitated by a current of an indifferent gas, like hydrogen. The analysis of the precipitate gave figures from which no simple formula can be calculated. The amount of phosphoric acid, in proportion to the lime, is greater than that corresponding to tribasic phosphate; and the amount of sulphurous acid is much less than that of the precipitate obtained by boiling. In accordance with the foregoing, the solution, after treatment with hydrogen gas, was found to contain less phosphoric acid, in proportion to the lime, than before.

Under reduced pressure, the phosphate solution boils easier, and the separation of the precipitate takes place more readily. This precipitate contains less sulphurous acid and more water than corresponds to the formula $3CaO,PO_5,SO_2,2HO$.

I experienced so much difficulty in preparing pure tribasic phosphate of lime, that I was obliged to use, for most of my experiments, the phosphate offered by nature in bones and bone-ash.

The compounds of phosphate of lime with sulphurous acid undoubtedly possess great scientific interest. This consideration, as well as the importance they are likely to attain for agricultural and sanitary purposes, as they have now become articles of commerce, has induced me to lay before you the results obtained so far in my investigation, with the prosecution of which I am still occupied.

THE COMMITTEE OF THE BRITISH ASSOCIATION ON THE TREATMENT AND UTILISATION OF SEWAGE

The following letter has been issued by the above committee to the municipal and sewer authorities throughout the country :—

I have the honour to inform you that, last year, at the meeting of the British Association, at Norwich, a committee was appointed to report on the treatment

and utilisation of sewage. In the first instance, a grant of £10 was placed at the disposal of the committee, with which to defray the cost of printing and postage incidental to the collection of preliminary statistical information. Through the kindness of Her Majesty's Government, the committee was enabled to obtain reports respecting the methods of dealing with town refuse practised in most civilised countries; and that information has now been collected in a more complete form than hitherto existed in any country.

This preliminary work being completed, the committee was re-appointed at the meeting of the British Association this year, at Exeter; and the inquiry was considered to present such important features of social and scientific interest, that the sum of £50 was voted towards enabling the committee to enter more fully and practically upon the investigation of this subject. The British Association, being a purely scientific body, has not at its disposal funds which would be adequate or applicable for the full prosecution of this very large and pressingly-important inquiry. The committee, nevertheless, desires to take advantage of the opportunity created by the British Association to investigate the entire subject in all its bearings—whether chemical, physiological, or engineering, sanitary, municipal, or agricultural—and in a manner worthy of the body they represent.

It is unnecessary to point out the enormous importance, especially at the present time, of a full and complete investigation of this question by the light of the knowledge and experience now gained in the several departments above alluded to. But, properly to carry out such an inquiry with a practical end, numerous observations, gaugings, and experiments, aided by simultaneous analyses, are essential; and these cannot be accomplished (especially the analyses) without the continued aid of efficient and, therefore, highly-paid assistants. Moreover, from time to time, it may be necessary for the committee to purchase expensive apparatus, and to subject various inventions and processes to a thorough and complete test; for it is the desire of the committee, not only to ascertain, as far as possible, the causes of the sanitary inefficiency of existing works, but also to inquire into every suggestion which affords promise of practical utility, in order that this investigation may be searching, the report practical, and any recommendations that may be made authoritative.

It is the wish of the several members of the committee to devote, to the utmost of their ability, their personal attention to the work thus sketched out; but the expenses absolutely necessary to enable them to conduct so extended an inquiry cannot but be very heavy, and, unless they are able to secure an adequate fund, they must abandon the attempt to investigate the subject in this broad and comprehensive manner. However, since there is no subject of greater practical and social importance to the public generally, and thus to the various municipal authorities and other governing bodies throughout the country, it is believed that many will share the opinion expressed at the recent meeting of the British Association, at Exeter—that the existence of this committee affords a specially favourable opportunity for such a wide inquiry; and, for that reason, its members confidently appeal to those authorities who are officially interested in the subject to supply the funds necessary for the investigation.

I am, therefore, desired to request that you will kindly submit this letter to the body you represent; and I venture to hope you will give the committee the benefit of your good offices in procuring a subscription proportionate to the population of your town or district.

. . . . I am, &c.,

George F. Barnes,
Honorary Secretary, *pro tem.*

22, Whitehall Place, London, S. W.,
November 18th, 1869.

CHLORINE AND METALLIC SODIUM.

BY J. ALFRED WANKLYN, F.C.S.

When chlorine gas is passed over metallic sodium—even when the metal is fused, and, whilst in a state of fusion, shaken in contact with the gas, so as to expose fresh metallic surface—there is no action. A glass vessel containing a piece of sodium was weighed; and, after the transmission of chlorine under the circumstances above named, it was re-weighed.

	grms.
Weight before the action of chlorine	7·847
Weight after the action of chlorine	7·863
Gain	0·016

The quantity of metallic sodium taken for the experiment was 0·770 grm.

SPECTROSCOPIC NOTES.*

BY PROFESSOR C. A. YOUNG,
OF DARTMOUTH COLLEGE.

September 4th, 1869.—Prominences were noted on the sun's limb at 3 p.m. to-day in the following positions, angles reckoned from North point to the East:—

1. +70° to +100°, very straggling, not very bright.
2. −10°, large and diffuse.
3. −90°, small, but pretty bright.

September 13th, 1869.—The following protuberances were noted this p.m.

1. Between +80° and +110°, a long straggling range of protuberances, whose form was as in Fig. 1. I dare not profess any very extreme accuracy in the drawings, not being a practised draughtsman, but the sketch gives a very fair idea of the number, form, and arrangement of the immense cloudy mass, whose height

Fig. 1.

was about 50″ and its length 330″ (22,500 miles by 1,350,000). The points *a* and *b* were very bright.

2. +135° small, but very bright at the base, of this form (Fig. 2).

3. −85° of this form (Fig. 3).

Fig 2.

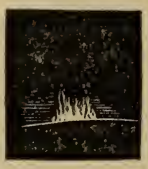
Fig. 3.

* From the October number of the *Journal of the Franklin Institute*. Kindly communicated, with the cuts, by Professor Morton.

The dark spot, marked *c*, was very curious, reminding one strongly of the so-called fish-mouth in the nebula of Orion. I saw no change in it for 20 minutes. On the other hand, the first series mentioned were changing rapidly, so that at five o'clock the sketch which was drawn at two was quite inapplicable, only the general features remaining unaltered.

4. −128°, about 20″ high, forked, thus:

Fig. 4.

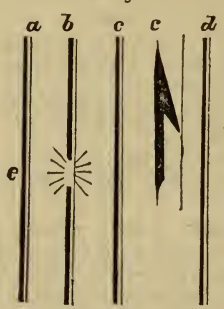


The structure was *cirrus* in every one but No. 3, which seemed more like a mass of cumulus.

To-day, for the first time, I saw b_1 reversed in the chromosphere when the slit was tangent to disc; 1474 was easy; the new line at 2602 cannot be detected as yet.

At 2·25, while examining the spectrum of a large group of spots near the sun's western limb, my attention was drawn to a peculiar double *knobbiness* of the F line (on the sun's disc, not at the edge), represented by Fig. 5, *a*, at the point *e*. In a very few moments a brilliant spot replaced the knobs, not merely interrupting and reversing the dark line, but blazing like a star near the horizon, only with blue instead of red light; it remained for about two minutes, disappearing, unfortunately, while I was examining the sun's image upon the

Fig. 5.



graduated screen at the slit, in order to fix its position, which was at −82½, about 43″ from the edge of the limb, about 15″ inside of the inner edge of the spot-cluster. I do not know, therefore, whether it disappeared instantaneously or gradually, but presume the latter. Fig. 5, *b*, attempts to give an idea of the appearance. When I returned to the eye-piece, I saw what is represented at Fig. 5, *c*, &c. On the upper (more refrangible) edge of F, there seemed to hang a little black mote, making a *barb*, whose point reached nearly to the faint iron line just above F. As given on Angström's atlas, the wave-length of F is 486·07, while that of the iron line referred to is 485·92 (the units being millionths of a millimetre). This shows an absolute change of 0·15 in the wave-length, or a fraction of its whole amount, represented by the decimal 0·00030, and would indicate an advancing velocity of about 55·5 miles per second in the mass of hydrogen whose absorption produced this barbed displacement.

The barb continued visible for about five minutes, gradually resolving itself into three small lumps, one on the upper and two on the lower line, Fig. 5, *d*. In about ten minutes more, the F line resumed its usual appearance. I did not examine the C line, as I did not wish to disturb the adjustments and risk losing some of the curious changes going on under my eye.

After the close of this strange phenomenon, I examined, with our large telescope of 6-inch aperture, the neighbourhood in which this took place, and found a very small spot exceedingly close to, if not actually *at*, the place. This was at 2.45. At 5.30 it had grown considerably.

Undoubtedly, the phenomenon seen was the same referred to by Mr. Lockyer, when he speaks of often seeing the bright lines of the prominences not only at the sun's limb but on his disc. It is the only time I have had the good fortune to see it as yet.

The common fire-fly gives a continuous spectrum without any trace of lines, either bright or dark. It is noteworthy that this spectrum lies almost entirely between the lines C and F, the portion of the luminous diaphason where the thermal and actinic effects are nearly *nil*, and where almost all the energy expended is effective as pure light. How different from our artificial modes, in which not more than one-tenth of one per cent of the expended energy appears as light, the rest being mostly wasted in heat, and partly in actinism.

Hanover, N. H.,
September 18th, 1869.

ON SOME TECHNICAL APPLICATIONS OF THE SPECTRUM MICROSCOPE.*

BY H. C. SORBY, F.R.S., ETC.

My object in publishing the following paper is to show that the spectrum microscope may be applied with advantage in several departments of technical inquiry, and more especially to describe the methods useful in such investigations. Since these will be much more readily understood by means of practical illustrations, I shall not make many general introductory remarks, but reserve an account of each particular process until I come to those practical questions which require its adoption.

In the first place, I beg to refer to my papers "On a Definite Method of Qualitative Analysis of Animal and Vegetable Colouring Matters,"† and "On the Colouring Matters of Blue Decayed Wood" ‡ since much that I shall describe will be a continuation and application of what they contain. I shall make use of the same scale for measuring the position of the absorption bands, and the same notation and symbols to express the varying power of absorption in different parts. This scale is an interference spectrum with dark bands, which divide the whole visible spectrum into twelve portions of equal optical value; and it is so adjusted that the sodium line, D, is situated exactly at 3½. On this scale the principal Fraunhofer lines occur as follows:—

A ..	$\frac{3}{4}$	B ..	$1\frac{1}{2}$	C ..	$2\frac{3}{8}$	D ..	$3\frac{1}{2}$
E ..	$5\frac{11}{16}$	*b* ..	$6\frac{12}{16}$	F ..	$7\frac{1}{2}$	G ..	$10\frac{5}{8}$

The only objection to this scale is that its accuracy is dependent on the careful preparation of the plate of quartz. I have myself made several perfectly alike and accurate, and nothing but proper care is required. When once accurately made, no scale could be more convenient, since the bands occur at equal optical intervals over the whole spectrum, and are quite distinct when the slit is opened rather wide, which is sometimes a great advantage. In these two respects it is far superior to any other scale hitherto proposed.

The intensity of absorption will be expressed by means of dots, hyphens, and dashes; thus:—

* Communicated by the author, having been published in the *Quarterly Journal of Microscopical Science*, vol. ix., new series, p. 358.

† *Proceedings of the Royal Society*, 1867, vol. xv., p. 432.

‡ *Quarterly Journal of Microscopical Science*, January, 1869.

Not at all shaded		Blank space.
Very slightly shaded	.	Single dot.
Slightly shaded	..	Double dots.
Moderately dark	– –	Double hyphens.
Very dark	—	Single dash.

When these symbols are printed *between* numbers they signify that there is a more or less strong absorption between those points of the spectrum as measured by the above-named scale; whereas when they are printed *under* numbers they signify that there is a distinct absorption band, of the intensity expressed by the different symbols, the *centre* of which is situated at that point of the scale indicated by the figures. This latter method is extremely simply and convenient, and often serves to express all that is requisite. It may, perhaps, appear imperfect to those accustomed to the study of the spectra of substances in the state of incandescence, but it is in all respects well adapted for the study of the spectra of solutions, in which a slight difference in the character of the solvent often makes far more difference in the position of the bands than any that could result from errors due to the employment of such a scale and notation. To hold the liquids under examination, I in most cases employ narrow, deep cells, usually one-eighth of an inch diameter, and half an inch deep, so mounted that they can be examined either in the line of the length or at the side; but occasionally I use rather wider, as much as two and a half inches long.

By using these narrow cells very much less material is required for successful examination, which is not only most important when very little is at command, but even in other cases often effects a considerable saving of time in filtration and evaporation.

I shall divide my subject into three principal heads, viz., 1. Various facts connected with wine; 2. Those relating to malt liquors; and—3. Such as illustrate the methods that may be employed to detect adulteration in various substances used as food or medicine.

1. *On the Colouring Matters of Wines.*

The pure colour of fresh dark grapes is best prepared by removing the skins, heating them in alcohol, evaporating the solution to dryness, redissolving it in a little water, filtering, and again evaporating to dryness in a small saucer, in which the colour may be kept as a stiff syrup for many months without material change. It belongs to the group of colours which I call group B in my paper in the *Proceedings of the Royal Society*—that is to say, sulphite of soda produces no immediate effect when added to a solution rendered alkaline by ammonia; but when added to one made acid with citric acid, it almost immediately removes the detached absorption in the green, so that the solution becomes very pale.

Since this colour of dark grapes is purple when dry and quite neutral, it may be called *Vitis purple*. I have not yet met with it in any other fruit, unless it be in that of the common crowberry (*Empetrum nigrum*). One of its peculiarities is that it easily passes into insoluble modifications. It belongs to my sub-group B al_o am_1, since it does not give any decided narrow absorption band in an alcoholic solution, when either neutral or with excess of ammonia. Such colours are amongst the most difficult to distinguish from one another, and I have not yet been able to discover any more satisfactory method than the following:—A slight excess of ammonia should be added to the alcoholic solution; made so dilute that the absorption in the orange part of the spectrum is distinct, but yet very far from black, and the position of the limit of the absorption towards the red end carefully measured and recorded, thus—1§ . . . .

The same limit should also be ascertained after considerable excess of hydrochloric acid has been added to the solution, both in water and in alcohol; which solutions sometimes give the same, but sometimes materially different, spectra. These various limits of absorption vary with the depth of colour, but by taking care to have solutions which give equally strong absorptions, and comparing them side by side, it is often very easy to distinguish from one another very closely allied colours—for example, that of dark gooseberries from that of grapes, or that of fresh grapes from that of new dark wines. The difference between these latter is proved, not only by the spectra, but also by other facts.

In my paper in the *Proceedings of the Royal Society* already cited (p. 443), I showed that when certain colouring matters are dissolved in water or alcohol, they give deep-coloured solutions, which rapidly fade to nearly colourless; but when these faded solutions are evaporated to dryness, the colour is completely restored to its original state, and is also made quite as dark as if it had never faded, by adding some strong acid; so that the fading is not due to decomposition, but to a molecular change rapidly taking place in dilute solutions. The colour of fresh grapes is an example of this; and by comparing with a standard which did not fade, the solution immediately after the colour was dissolved, and the same after less than an hour, when no further change occurred by keeping it longer, I found that the faded required fully five times the thickness to give the same intensity of absorption at the yellow end of the green. On the contrary, new dark wines evaporated to dryness do not fade at all in such a manner when re-dissolved in water.

This colour of new wines appears to be produced at a very early part of their formation. By dissolving the colour of the fresh grapes in the juice, adding a little yeast, and keeping the solution warm for a few days, the colour appeared to be changed into that found in new wines, and did not fade at all when re-dissolved in water. The colour kept as dry syrup for three years showed a similar change. I think it must be, therefore, due either to fermentation or to a slight oxidisation. I am much inclined to adopt the latter explanation, for if citric acid be added to an aqueous solution of the fresh colour, and then a small quantity of hypochlorite of soda, the colour is changed from pink to pink-red, the absorption is found to extend more towards the red end, and to be more uniform over the green and blue; in all which particulars it corresponds with the spectrum of new wine. No such change occurs when the wine is treated in the same manner as though this alteration had already taken place. Both these colours belong to my group B; but when either is still further oxidised by means of rather more hypochlorite of soda, a sort of orange colour is produced, which seems to correspond with that of port wine kept for twenty years or more in the cask; and when still further changed, it becomes quite pale, like very old wines. The following table will show these facts more clearly:

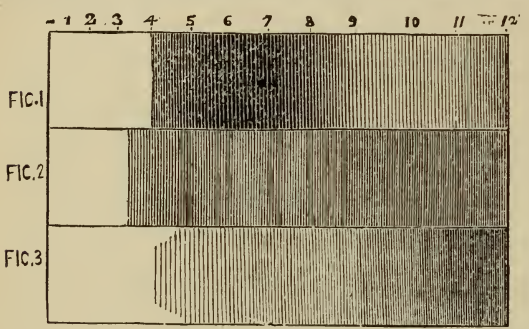
Colour of dark grapes in citric acid and water	4	..	4¼	–	–	8¼	..	11	–	–
Ditto, after adding a little hypochlorite of soda	3¼	..	3¼	–	–	–				
New natural port wine	3¼	..	3¼	–	–	–				
Ditto, after adding a little hypochlorate of soda	3¼	..	3¼	–	–	–				
Colour of dark grapes with more hypochlorite of soda	5	..	6	–	–	10	—			
New natural port wine with ditto	5	..	6	–	–	10	—			
1834 port from the cask	5	..	6	–	–	10	—			

Since this change in the spectrum depending on the

[English Edition, Vol. XX., No. 524, pages 279, 280.]

state of oxidisation is of considerable interest as illustrating a general law, I here subjoin a woodcut,* in order to render more intelligible to those not accustomed to the use of the symbols employed in the above table. Fig. 1 shows the spectrum of the colour of dark grapes in its natural state, in citric acid and water. Fig. 2 is the spectrum of the oxidised modifications met with in new wines; and Fig. 3 that of the per-oxidised colour found in very old wines, or formed by the more complete artificial oxidisation of the other two.

This colour of very old wine belongs to my group C, and is not changed by adding sulphite of soda to an acid solution; whereas, as already mentioned, the characteristic colour of very new wine belongs to my group B, and if it could be obtained in a pure state, would probably become nearly colourless on the addition of the sulphite. This difference between the colour of new



and old wine has enabled me to contrive a method by means of which I can ascertain the approximate age of port wine kept in the cask. In these experiments I have been very much assisted by my friends, Mr. Joseph Prestwich, F.R.S., and Mr. Alexander Hay, of Sheffield, who have most kindly supplied me with the requisite samples.

On the Age of Dark Wines.

In order to obtain good results considerable care is required, and after trying several methods I found the most satisfactory was as follows:—I have two experiment cells one inch long, made from stout tube, having an internal diameter of about a quarter of an inch. Both ends are cut square, and one is fastened to a piece of glass like a microscopical object by means of purified gutta percha. This I find a most valuable cement for such purposes, since it resists the action of alcohol, acids, and alkalies. The glass must be heated until the gutta percha is sufficiently soft. One of the tubes is carefully graduated into ten equal parts, and the other left plain. Wine in its natural state is often much too dark coloured to enable us to recognise the effect produced by adding sulphite of soda, when we examine the spectrum of the thickness of one inch. It is, therefore, requisite to dilute it with so much of a mixture of one part of alcohol with three of water that the spectrum of the light which has passed through the experiment cells may show a strong, but by no means complete, absorption of the light in the yellow and in the yellow end of the green. After diluting some of the wine to this extent, and adding so much citric acid that it may have a very strong acid reaction, it should be poured into two test-tubes, powdered sulphite of soda dissolved in one, and the other kept without. Though the sulphite may produce a very considerable change at once, the alteration is not complete for a while, and therefore it is best to keep the solutions for an hour or two in the tubes, corked up to prevent evaporation. The point to be then determined is, how much less thickness of the diluted wine to which no sulphite has been added will give exactly the same intensity of absorption in the yellow, and in the yellow end of the green, as the thickness of one inch of the same acted on by the sulphite of soda. The ungraduated tube should, therefore, be filled with the latter, and a small piece of thin glass placed on the top, so that the light may pass through exactly one inch in thickness of the liquid, and none run out when the tube is placed in an inclined position on the side stage of the spectrum eye-piece. The diluted wine should then be introduced into the graduated tube, which is placed nearly vertically on the ordinary stage of the microscope, and the depth of the liquid carefully regulated by means of a pipette, so that the intensity of the absorption in the two spectra may be exactly the same in the yellow and in the yellow end of the green. The light must be of the same intensity in both spectra; and, therefore, it is also particularly necessary so to regulate the instrument that the transmitted red rays may be of exactly the same brilliancy. The accuracy of this experiment is limited by the difficulty of recognising when the transmitted and the absorbed rays are equal in both spectra, and by its being difficult to determine the depth of the diluted wine to less than 1-100th of an inch. The actual value of the measurements varies, to some extent, according to the manner in which the experiments are made; and, therefore, I strongly advise any one who may wish to employ this method to prepare for himself a table of the comparative amount of change of wines of various ages.

When sulphite of soda is added to a faded solution of the colouring matter of fresh dark grapes it is changed to a pale orange yellow, which colour is, I believe, due in great measure to the presence of the same yellow substance as is met with in green grapes, so that the intensity of absorption is reduced to about 1-10th, or from 1·00 to 0·10. In the case of the perfectly new wine prepared by myself, the intensity of absorption was reduced from 1·00 to about 0·22. My experiments with the wines of commerce were chiefly made in April, 1868. The newest port wine that I was able to examine was of the vintage of 1866, and therefore about one year and a half old, and even this contained a good deal of the C colour. I examined several specimens of the same vintages of various older dates, which differed considerably in general colour and character, but when all had been kept for the same time in the casks I did not find any material difference in the general results. From the manner in which the experiments were made, the change produced by adding the sulphite of soda is referred to the amount of the C colour taken as unity; and, assuming that the extent to which the wine has been altered by keeping is the difference between the amount still unchanged and unity, the numbers given indicate the relative changes produced by the slow action of the air, but they can only be looked upon as expressing the rate of one particular kind of change. The following table has been constructed from the whole of my observations, so as to give a good general illustration of the subject.

* We are indebted to Messrs. Churchill and Sons for the use of this woodcut.

Column 1 shows the age of the wine in years and the date of the vintage.

Column 2 gives the thickness of the diluted wine without sulphite, which produced the same intensity of absorption as 1·00 inch of that to which the sulphite had been added.

Column 3 shows the difference between the values in column 2, divided by the number of years between each two, so as to exhibit the amount of change for each year, after the wine had been kept for the various periods:—

I.	II.	III.
0 ..(Made by myself).	0·22	
		0·2700
1½.....(1866).....	0·63	
		0·0700
2½.....(1865).....	0·70	
		0·0300
3½.....(1864).....	0·73	
		0·0200
4½.....(1863).....	0·75	
		0·0150
5½.....(1862).....	0·76½	
		0·0150
6½.....(1861).....	0·78	
		0·0070
9½.....(1858).....	0·80	
		0·0030
16½.....(1851).....	0·82	
		0·0020
20½.....(1847).....	0·83	
		0·0008
33½.....(1834).....	0·84	
		0·0007
47½.....(1820).....	0·85	

Since the above table does not refer to wines of even years of age, I subjoin below another derived from it by laying down the results on paper as a curve, and interpolating by careful measurements:—

I.	II.	III.
0.....	0·220	
		0·330
1.....	0·550	
		0·120
2.....	0·670	
		0·050
3.....	0·720	
		0·022
4.....	0·742	
		0·017
5.....	0·760	
		0·012
6.....	0·772	
		0·010
7.....	0·782	
		0·007
8.....	0·790	
		0·005
9.....	0·795	
		0·005
10.....	0·800	

It will thus be seen that the rate at which the B colour changes into C is far more rapid in the case of new wine, when much of it is present, than after the wine has become older; being, in fact, about ten times as rapid in the first year as in the third, and about 100 times as rapid as in the twentieth. On this account, the difference for each year is at first so considerable that wines of different vintages could easily be distinguished; but after about six years, the difference is so small that it would be difficult, or impossible, to determine the age to within a single year. After twenty years, a difference of even ten years does not show any striking contrast, and the age could not, therefore, be determined to nearer than ten years by this process. However, up to six years I think it quite possible to determine the age to within a single year. I took specimens of various ports from the casks, of different ages up to six or seven years, and labelled them in such a manner that I did not know the age of any, but could ascertain it afterwards by reference, I then made the experiments with great care, and found that, by proper attention to the details described above, I could correctly determine the year of vintage of each particular specimen.

As already mentioned, the change of the B colour into the C is most probably the effect of the oxygen of the air, which appears to act slowly through the wood of the cask; but the relative amount of these two colours is also modified by the deposit of crust. When kept in well-corked bottles, the change does not appear to be the same, and goes on far more slowly. I therefore think it would be scarcely possible to ascertain the length of time that the wine had been in bottles, and am inclined to believe that the amount of change observed on adding sulphite of soda corresponds more closely with the time that the wine had been previously kept in the cask. I have especially observed this in the case of Bordeaux and Burgundy wines. Those of this type which I have hitherto examined seem to contain a larger relative amount of the B colour, when a few years old, than ordinary ports, and in this respect agree with the so-called *natural port;* but the rate of change is greater when they are kept for some years, probably owing to their containing a less amount of alcohol. There is also a greater variation in different samples of the same age than I have met with in port wine, which is probably because the amount of alcohol in such wines varies more in proportion to the total quantity.

It appears, therefore, that the natural colour of dark grapes is changed by oxidisation into the somewhat similar colour found in new wines, and that, by still further oxidisation, this is converted into another entirely different colour, which becomes much paler by further oxidisation. The rate at which these changes take place varies according to circumstances, but, other things being equal, it varies according to the time of the action. Much also depends on the deposition of colour in the form of crust, and after a long time the original dark coloured substance is almost entirely lost, and only an amber colour remains in solution, which behaves with reagents precisely like that in sherry wines.

On White Wines.

The colouring matter of white wines appears to be derived from one of those yellow substances, soluble in water, of which there are several of materially different character in the faded leaves of different kinds of plants, as more fully described hereafter when treating on hops, That met with in the orange-coloured leaves of the beech is a good example. The depth of the colour is made nearly ten times as great by the addition of ammonia, and when dissolved in strong sulphuric acid diluted with an equal bulk of water, oxidising reagents first turn it much darker, and then much paler. When, however, kept for some months dissolved in dilute alcohol it turns to a much darker tint, and then the solution, with excess of ammonia, is only twice as dark

as when made acid by citric acid. Oxidising reagents added to the solution in sulphuric acid do not make the tint any deeper, and thus it appears as if it had been changed by oxidisation into an entirely different colour. The character of this change agrees with what occurs when the colour of dark grapes is oxidised, as already described; and both are good examples of what appears to be a general law. If not already oxidised, a certain amount of oxidisation causes the absorption to advance towards the red end of the spectrum to an extent varying according to the position of the original absorption, and then a still further oxidisation causes the absorption to recede from the red end to considerably beyond the original position, sometimes so much so that all colour is lost. We might thus say that such substances may occur in an unoxidised, in an oxidised, and in a per-oxidised condition. These and similar facts seem also to show that there is an intimate relation between the chemical changes and the particular rays of light absorbed by such substances; but the discussion of this very interesting question would lead me far away from the more immediate subject of this paper.

On comparing the colour of sherry wine with that produced by the action of the air on a solution in dilute alcohol of the substance in faded beech leaves soluble in water, I was unable to discover any difference, and hence I think we may conclude that it is formed by the oxidisation of the yellow colour of the grapes; but in some wines it is imperfectly oxidised, and they turn darker when exposed to the air.

Adulterations of Wine.

The only cases in which the spectrum method can be easily applied to detect adulterations in wines are when some colouring matter has been introduced to give a false appearance of age, or to bring the colour up to some desired standard. According to Payen's interesting work, * logwood and Brazil wood were at all events employed a few years ago for this purpose; and rhatany root and the berries of the so-called *Virginian Poke* (*Phytolacca decandra*) are sometimes used. I mention these because I purpose to briefly describe how they may be detected, as an illustration of the methods which may be employed in such investigations. I must, however, confess that I have not detected these substances in any wines of commerce that I have yet examined; but then I have had very little opportunity for studying those likely to contain them.

In order to detect logwood or Brazil wood, a small quantity of the wine should be agitated in a test-tube with an equal volume of ether, which rises to the surface in an almost colourless state if the wine be pure, but is tinged with a more or less strong yellow when either of the above-named substances is present. The ethereal solution should be transferred to a small evaporating dish by means of a pipette, and a fresh quantity of ether agitated with the wine, and added to the other. The most useful kind of pipette for this and similar purposes is one with a small vulcanised india-rubber top, so arranged that, after having been compressed, it may, by its own elastic force, draw up the liquid. After evaporating the solution to dryness, a small quantity of the colour should be dissolved in water in an experiment cell, and treated with bicarbonate of ammonia. In both cases this developes a single very distinct absorption band in the green, that characteristic of logwood being situated at 4⅜ of my scale, whilst that of Brazil wood is farther from the red end, at 5¼; and the solution is strongly fluorescent, of a peculiar orange colour. These spectra are so characteristic, and can be so easily compared with those of the substances themselves, that an extremely minute quantity of either could be detected with certainty.

The colour of rhatany root does not give any well-marked band in an aqueous solution, either acid or alkaline; but when dissolved in alcohol and slightly acid, it shows a moderately distinct band between the yellow and green, at 3¾ of my scale, and a fainter at 7¼. In order to detect this substance the wine should, therefore, be evaporated to small bulk, and re-dissolved in strong alcohol, and after this has stood in a test-tube until the insoluble matter has been deposited and the solution has become quite clear, the absorption band at 3¾ may be more or less distinctly recognised, according to the amount of the rhatany root present; but the natural colour of the wine makes it impossible to detect a very small quantity.

The dark crimson berries of the Virginian poke are remarkable for containing a colour belonging to my group C; whereas those of nearly all fruits of that tint belong to group B. It shows two absorption bands, which are more distinct in an alcoholic than in an aqueous solution, and are 4⅜, 7⅜. To detect this substance we ought, therefore, to adopt the same process as in the case of rhatany root, and endeavour to see those bands, which might sometimes be made more distinct by adding a little water and sulphite of soda.

These substances may be changed by keeping long in solution, and therefore might not be detected in old wines.

On the Application of the Spectrum Microscope to the Chemistry of Beer.

In studying the colouring matters in beer, it is, in the first place, desirable to understand those met with in the various substances used in brewing; but it is unnecessary to take into consideration colours insoluble in water.

When malt is digested in hot water, an orange-yellow colouring matter is extracted; but the solution contains so much sugar and gum as to interfere with the necessary experiments. It should, therefore, be evaporated to the consistency of syrup, alcohol added by degrees, and the precipitated gum and sugar well stirred up, so that as much colouring matter as possible may be dissolved. After standing till quite clear, this solution, on evaporation, yields a pale orange-yellow syrup, which, when dissolved in water or alcohol, gives a spectrum without any decided characters. Ammonia makes it a deeper and brighter yellow; and the same change occurs when it is dissolved in sulphuric acid. In all these experiments, a mixture of equal volumes of the concentrated acid and water should be used; for, if much stronger, it chars vegetable substances, and, if weaker, it does not act well with the reagents added to it. When dissolved in this, the colour of malt is made much darker by the addition of nitric acid or chlorate of potash; but an excess of the latter makes it rapidly fade to a pale yellow, whilst hypochlorite of soda, in small quantity, makes it somewhat more orange, and more makes it a very pale yellow. The characteristic test is hypochlorite of soda, added to an aqueous or alcoholic solution in which a little citric acid has been dissolved. The addition of a suitable quantity of the hypochlorite turns the aqueous solution to a pink

* "Précis des Substances Alimentaires," note at p. 455.]

flesh-colour, becoming deeper; but it is not clear, and, on standing, a copious pink flocculent deposit subsides. When seen to the greatest advantage, the spectrum is 4 - - 8 . . 10 - - 11—, without any decided narrow absorption bands. If, however, the colour was dissolved in alcohol, the solution remains clear; there is a well-marked band at the yellow end of the green, which at first is 4½, and, as the colour becomes deeper, is more distinct, and rises to 5. The flesh-coloured deposit from the solution in water is easily dissolved by alcohol, and gives the same spectrum; and these facts are so unique that this colouring matter could be easily recognised in complicated mixtures. It certainly does not occur in barley, and must, therefore, be formed in the process of malting. Water extracts from barley a brown colour, insoluble in alcohol, which exactly corresponds with that of liquorice; and also a yellow colour, soluble in spirit, which does not exactly correspond with that obtained from hops, but yet differs from it in such a manner that, taking all the facts into consideration, it seems probable that it is the same colour in a less pure condition.

When hops are boiled in water, the solution evaporated, and the gum, &c., removed by alcohol, as already described, an orange-yellow colour is obtained which, in general appearance and in its behaviour with most reagents, is extremely similar to that from malt. It may, however, be easily distinguished by the action of hypochlorite of soda; for, when this is added to an aqueous solution previously treated with a little citric acid, it merely changes it to a very pale yellow, without any shade of pink. This colour, or, at least, colours, which I have not been able to distinguish from it, is met with in several kinds of faded leaves, stems, and roots, and seems to be very generally distributed.

When the partially-charred malt used in brewing porter is digested in water, a dark solution is obtained; and, on evaporation to small bulk and treatment with alcohol, nearly the whole of this dark colour is precipitated along with the gum. To obtain it more pure, it may be re-dissolved once or twice in a little water, and re-precipitated by alcohol. When dissolved in water, it gives an orange-brown solution, with a spectrum . . . 4 . . 5 - - 6—, made somewhat darker by ammonia; and, when dissolved in sulphuric acid, the colour and spectrum are nearly the same. Oxidising reagents do not make it any darker in either solvent, but merely cause it to fade to a pale yellow.

Besides this dark colour, highly-dried malt contains an orange-yellow, soluble in both strong alcohol and water. This differs from that obtained from pale malt, in not being turned at all pink by the action of hypochlorite of soda, and is distinguished from the colouring matter of hops or of beer (with which it agrees in general colour) by not being made at all darker by the addition of oxidising reagents to the solution in sulphuric acid, as if it were already in an oxidised condition.

Liquorice is chiefly coloured by a brown substance, which closely resembles that present in dark malt. When alcohol is added to the strong aqueous solution, it is precipitated in the same manner; and when dissolved in water the general colour is very similar, though rather more orange. They may, however, be easily distinguished by the action of oxidising reagents. If to solutions in sulphuric acid of equal depth of colour equal quantities of chlorate of potash be gradually added, the malt first becomes a much paler orange, and then pale yellow; whereas the liquorice turns to an orange, which does not become pale until very much more chlorate has been added than suffices to make the malt very pale. Though they can thus be easily distinguished, yet when mixed together, as in porter, it is not easy to obtain decided results. The change of colour is very similar in kind, and differs only in degree; so that the addition of too much chlorate may make the liquorice as pale an orange as the malt; and when not much liquorice occurs mixed with malt, it becomes very difficult to recognise it. Still, however, with care its presence may be detected in ordinary porter.

That colouring matter of porter which is soluble in strong alcohol behaves with reagents like a mixture of those from beer and dark malt. Hypochlorite of soda turns the solution in sulphuric acid to a red, but of a less deep tint than in the case of beer.

The sweet wort obtained in brewing contains the colour of malt, already described, and, after boiling with hops, the hop colour; but after fermentation a change is found to have occurred, which proceeds still further when the beer is kept in the barrel. This change is best shown by the addition of hypochlorite of soda to the solution of the colouring matter in sulphuric acid. The gum, &c., should be removed by means of alcohol, in the manner already named when describing malt. Taking two experiment cells, and dissolving in one the colour of the unfermented wort, and in the other an equal quantity of the colour of beer that has been kept some months in barrel, the general tint is seen to be very similar. Since the solutions are otherwise apt to be turbid, it is best to fill the tubes three-fourths with the sulphuric acid diluted with an equal bulk of water, and then to fill up with alcohol, after which the coloured syrup can be added on a platinum wire, and made to dissolve by stirring. On adding little by little hypochlorite of soda to such a solution of the unfermented wort, it first turns it a little more orange, and then pale yellow; whereas, in the case of the beer kept in barrel, it is first gradually changed to a deep pink-red, which, when strong, is 3 . - 4—, and when seen to the greatest advantage is 5 - - 7½ . . . 9½ - - 10—, having, therefore, a broad absorption band at 6½. On adding more hypochlorite it becomes more orange, and finally an orange-yellow. The fermented wort behaves in an intermediate manner; and hence it should appear that the change begins during fermentation, and is continued when the beer is kept in barrel. Still, however, it does not seem to depend simply on fermentation, since no such change occurs when fermented on a small scale; and, therefore, it may perhaps be due to deoxidisation, which would be more likely to take place in a large quantity less exposed to air.

If in any case it were desirable to ascertain whether or no any mixed liquid contained beer, the various reactions with the reagents already mentioned might enable us to form a very decided opinion when other tests failed; but so much would depend on the circumstances of the case that no general rule could be given.

On Some Adulterations of Malt Liquors.

I have made very many experiments in order to ascertain how far the spectrum method can be employed in detecting adulterations in beer. Many of the substances used are added in such quantities, and impart so little colour, that there seems to be no chance of discovering them by their spectra. I have chiefly directed my attention to those employed as substitutes for hops, such as picric acid, gentian root, calumba root, and the entire plant of *Ophelia chireta*, commonly known by the more

simple name of chiretta. So far I have not been able to detect any difference between the colouring matter of gentian, or chiretta, and hops. They all give the same reactions and spectra with the various reagents, or at least so nearly the same that there appears to be no chance of detecting them in the presence of the colouring matter of wort or beer. Calumba root, however, contains two colours, one of which is quite different from any that should occur in genuine malt liquors. The exterior part of the root is yellow, and water extracts from it a bright yellow colour. The interior part is browner, and does not contain this yellow, but a browner colour, which also occurs to some extent in the outer layer. On evaporating the aqueous solution to small bulk and re-dissolving in alcohol, this brown colour is left insoluble, but the bright yellow colour remains in the alcohol in a curiously turbid condition. The brown colour appears to be identical with that found in liquorice, and could not be detected by any of the reagents; but the yellow colour may be recognised, if beer has been adulterated by a moderate amount of calumba root. When dissolved in water or alcohol it is a very clear, bright yellow, but gives no well-defined spectrum. Ammonia makes it slightly orange, and when dissolved in sulphuric acid it is the same bright yellow as in water. Oxidising reagents, such as hypochlorite of soda, produce no change in weak acid solutions; but when added to the solution in sulphuric acid they alter it into a deep red colour, changed into an orange-yellow by excess. Deoxidising reagents, such as hyposulphite of soda, restore the deep red to the original yellow. The most useful test in connection with the various other colours already described is hypochlorite of soda gradually added to the solution in sulphuric acid. This first makes it a deep red, giving the spectrum 3 . . 4 - —, and the addition of a little more produces scarcely any further change; but when large excess has been added it fades to an orange, giving the spectrum 6 . - 7 —. The colouring matter of fresh wort treated in the same manner is not turned at all red, and though the colour of finished beer is changed to red in a very similar manner, yet, after so much hypochlorite has been added as to turn it deep pink-red, a very little more makes it pale yellow. We may take advantage of this circumstance to detect calumba root.

In examining any suspected beer, it, and a similar quantity of genuine, should be evaporated in separate dishes, so that the results may be more accurately compared. The presence of calumba root is first somewhat betrayed by the fact of the resin, which separates on evaporation, being abnormally yellow, and when the syrup is dissolved in alcohol, and the solution evaporated to dryness, the purified colour is decidedly brighter yellow than it ought to be. Taking, then, two experiment cells, so much of the colour of the genuine beer should be dissolved in one—in sulphuric acid—as to give a decided orange yellow, with a spectrum 5 . . 6 - - 7—; and in the other cell so much of the suspected material as to give a colour of about the same tint. In both cases, about one-fourth of the bulk of the liquid should be alcohol, so as to prevent the formation of any precipitate. Hypochlorite of soda should then be added very gradually, and in equal quantities to both, when at first both will change to red, having a pinker tint in the genuine. After so much has been added as to make both as dark as they can become, a little more will turn the genuine to a pale yellow, giving a spectrum 7 . . 8 - - 9—; whereas that containing calumba root will remain a fine red orange, with a spectrum $3\frac{1}{2}$ . . $4\frac{1}{2}$ - - 5—. If too large a quantity of the hypochlorite be added, the colour of the calumba root will change into a much paler yellow, scarcely differing from that in the case of genuine beer, and hence particular care must be taken to add it gradually, and in small quantities. By this means, the adulteration of beer with 2 ozs. of calumba root to the gallon may be detected with confidence; but much less than that would scarcely give reliable results, unless it were possible to examine the unfermented wort. The addition of the hypochlorite to genuine wort does not turn it at all red, and merely alters it to a pale yellow; whereas, if calumba be present, it turns it to a decided red.

Picric acid may be detected when present in no larger quantity than 1 grain to a gallon. When dissolved in water, it is of a bright yellow colour, and cuts off the blue end of the spectrum in a sufficiently well-defined manner, giving the spectrum $8\frac{1}{2}$ . . . This is not changed by ammonia or citric acid, nor does hypochlorite of soda cause it to fade when added to an acid solution. The most striking change is that produced by the addition of sulphuric acid, which makes it so much paler that a couple of drops added to the aqueous solution in one of the small cells leaves it nearly colourless. In order to detect it in beer, about 1 oz. should be evaporated to dryness, and then re-dissolved in no more water than will make the solution sufficiently liquid to allow bubbles to rise readily through it. This should be introduced into a test-tube and agitated with ether, which dissolves out the greater part of the picric acid, but scarcely any colour, from genuine beer. Since it is very important to avoid contamination with any of the material not soluble in ether, it is well, in the first case, to use somewhat more than the bulk of the concentrated beer, and to transfer it to another *perfectly dry* test-tube, then agitate with a fresh quantity of ether and add it to the first, arranging so that the total amount of ether may fill a $\frac{1}{2}$ inch test-tube to the depth of about 2 inches. After corking it up, it should be allowed to stand till quite clear, and till any particles not soluble in ether have adhered to the sides of the tube. The clear solution should then be poured off into another tube, water added so as to give a depth of about half an inch, and well agitated with the ether. After it has collected at the bottom, the ether should be removed by a pipette, the aqueous solution washed with a little fresh ether, and then evaporated to dryness. In the case of genuine beer the ether extracts scarcely any colour, and the greater part of this and the resinous matter afterwards remain in the ether, so that on evaporating the aqueous solution, which is scarcely coloured, a mere trace of a yellow colour is obtained, so free from resin that, when dissolved in water and a drop or two of alcohol added, we obtain a clear, very pale yellow solution, so pale that if one ounce of beer has been used, the spectrum is about 10 . . 11.—, changed to about 9 . . 10 - - 11—by sulphuric acid. If, however, picric acid be present, the solution in ether is a decided clear bright yellow; the greater part of the colour is extracted from it by the water, and on evaporating to dryness more or less of a clear bright yellow is obtained. If as little as a grain per gallon were present, when dissolved in water with a drop of alcohol, a clear bright yellow solution would be obtained, giving the spectrum 8 . . . made much paler by the addition of sulphuric acid, which decolourises the picric acid, and merely shows the colour of the beer itself, which, if one ounce had been used, and all the product introduced into the experiment cell, would not be deeper than 9 . . 10 - - 11—, or very decidedly paler than what would be seen before the addition of sulphuric acid, if even less picric acid than one grain per gallon had been present in the beer.

I have not been able to discover any essential difference between the colouring matter of *Cocculus Indicus* and that

of liquorice; and though it would be difficult to prove it in a positive manner, yet I think it very probable that a small quantity of this colouring matter is the cause of the brown colour of chiretta, and of the slighly brown tinge in hops. It would, therefore, be impossible to detect *Cocculus Indicus* in porter by means of its colouring matter, even if present in far larger amount than is ever likely to be the case.

Though the detection of turmeric in beer does not necessarily depend upon the spectrum microscope, yet the method employed is so closely related to our present subject that it may be well to describe it. The best test for its presence is the very strongly fluorescent character of the solution in benzol. The alcoholic solution is much less fluorescent. In order to be able to detect fluorescence and examine the spectrum of the dispersed light, I have found it very convenient to make use of cells about three-quarters of an inch deep, made out of moderately thick barometer tube, having an internal diameter of about one-sixth of an inch, cut square, and polished at one end, and melted up at the other, which is fixed into a small brass foot by means of black sealing-wax. On introducing a clear solution, covering it with a small piece of thin glass, illuminating the tube at the side by strong daylight, and looking down the axis, the liquid appears quite black, if it be not at all fluorescent, for no light is reflected from either the apparatus or the liquid; whereas, if fluorescent, it looks more or less opaque and of a colour depending on the nature of the substance. Such tubes can easily be placed on the stage of the microscope, and the spectrum observed, which, in some instances, is remarkable in showing one or more narrow bright bands.

In the case of turmeric, a very minute quantity dissolved in benzol gives a beautiful more or less blue-green fluorescence, with no special dark or bright bands. Half an ounce of the suspected beer should be evaporated to so small a bulk that it may occupy only about half an inch in the depth of a test-tube half an inch in diameter, and an equal amount of benzol added to it, with about an equal quantity of alcohol; since, without this last, the globules of benzol collect together with extreme slowness. After well agitating the whole, the tube should be set aside until the benzol has collected at the top, as a clear solution, which must then be introduced into one of the cells just described, by means of a pipette. In the case of pure beer, this solution is of a faint yellow colour, but is scarcely at all fluorescent. If no more than one grain of turmeric has been added to a gallon of beer, the fluorescence is so strong that it could not be seen to greater advantage, and even as little as one-tenth of a grain per gallon may be detected with confidence.

It will thus be seen that the spectrum method of study serves to throw considerable light on some of the changes that take place in the process of brewing, and would also enable us to detect the presence of some adulterations; but, at the same time, it would always be requisite to bear in mind that it is possible that some of the colouring matters I have described may themselves become altered when kept in solution for a considerable time.

Adulteration in Drugs, &c.—Mustard.

I now proceed to describe the detection of adulteration in a variety of substances. Having just explained the method to be employed when the presence of turmeric is suspected, it may perhaps be well to mention now all that need be said on that substance. Its presence may easily be detected in nearly all the ground mustard sold in the shops; and, as far as I am able to judge from the intensity of the fluorescence, the amount varies from about one-third to one-half per cent.

The natural seeds contain a yellow colour soluble in water, which is the same as that found in many yellow leaves; another yellow colour, insoluble in water, but soluble in alcohol, which corresponds with the xanthophyll of yellow leaves; and there is also often present a small quantity of chlorophyll in the imperfectly ripe seeds. The powdered mustard should be digested in alcohol, about an equal quantity of water added, and the solution filtered. On agitating with benzol this rises to the top, with the colour of the turmeric in solution, which can be easily detected by its strong green fluorescence. Chlorophyll, if present, would give a red fluorescence, and by transmitted light, a spectrum with well-marked absorption bands.

Rhubarb.

The same process may be successfully employed in the case of rhubarb; and as small a quantity of turmeric as 1-10th per cent may be detected in no more than 2½ grains of rhubarb. There is not the least difficulty in distinguishing, by this means, inferior pale rhubarbs coloured by turmeric, so as to resemble those of the best quality.

The detection of small quantities of gamboge, added to increase the purgative action of these inferior kinds, is not so easy, and requires some care, especially in the presence of turmeric. The suspected powder should be placed on a small filter, and so little alcohol added as will give a few drops of clear solution, which would contain a comparatively large amount of the very soluble gamboge, and but little of the less soluble colour of the rhubarb itself. This alcoholic solution should then be agitated with bisulphide of carbon, and the supernatant alcoholic solution removed by means of a pipette and blotting-paper, and the solution in the bisulphide evaporated to dryness. This would contain a colour peculiar to the different kinds of rhubarb, and, perhaps, also turmeric and gamboge. If a small quantity dissolved in benzol gives the green fluorescent solution, turmeric is present; and, in order to detect the gamboge, it would then be requisite to re-dissolve in alcohol and add a little nitric acid, which so changes the colour of the turmeric that it is no longer removed by agitating with bisulphide of carbon; whilst the gamboge remains unchanged, and is abstracted by it from the alcoholic solution. After separating this, evaporating the bisulphide to dryness, and re-dissolving in alcohol, a small quantity of an alcoholic solution of iodine should be added, and then excess of ammonia, a little sulphite of soda, and a drop of water, to make it dissolve. This ensures the complete removal of any free iodine that may remain after the addition of ammonia.

In the case of pure rhubarb, this solution when sufficiently but not too strong, has a decided pink colour, giving no well-marked absorption band in any part of the spectrum, but transmitting the blue rays very considerably better than the green; whereas, when gamboge is present to the extent of 2 per cent or upwards, the yellow colour due to it cuts off the blue light, and the solution is orange colour. The spectra are as follows:—

Pure rhubarb.....	4 ... 8	9..10--11—
Rhubarb, with 2 per cent of gamboge.....	4 ... 9	-- 10—
" " 4 "	4 ... 8	-- 9—
Gamboge alone.....	7 ... 8	-- 9—

In very many other cases, bisulphide of carbon is a most valuable reagent to separate different colours. An

excess should be agitated with the alcoholic solution, when it sinks to the bottom, carrying with it the whole of some colours, and leaving the alcohol quite colourless. Other colours are only partially removed; whilst others are not abstracted in the least degree. These last are usually, but not always, those soluble in water; whereas, those easily removed are usually, if not always, insoluble in the liquid.

The cells for the examination of the spectra of solutions in bisulphide of carbon, ether, chloroform, or benzol, should be fixed to the glass plate by means of a mixture of glue and honey, made so as to be quite stiff, but yet to melt when warmed. Cells so cemented must be washed out with the liquids named above, and never with water or hydrous alcohol. The spectra of colours dissolved in the bisulphide are far more characteristic than when dissolved in any other liquid. So far I have met with between two and three dozen different vegetable colours soluble in this reagent. The absorption bands are much farther removed from the blue end, when they occur in that part, so as to be far more distinct; and their position is not subject to variation from any change produced by evaporation, as in the case of ordinary alcohol, which may thus become more weak, and give the bands in a very different situation.

On the whole, the spectra are so characteristic and uniform that different colours, soluble in bisulphide of carbon, may usually be recognised in a very satisfactory manner by means of the spectrum of that solution alone; and this is fortunate, since such colours can seldom be distinguished by their behaviour with reagents. The dried colour must be dissolved in fresh bisulphide, since, when it separates from the alcohol, it contains some of that liquid in solution, which alters the position of the bands. As an illustration of what may be done, I give a few examples:—

Cheese.

Cheese of orange colour was digested in bisulphide of carbon, the solution washed by agitating with alcohol, and evaporated to dryness. On re-dissolving in alcohol diluted with a little water, a considerable amount of oily matter was separated; and, after evaporating the clear solution to dryness, and re-dissolving in bisulphide of carbon, it gave the spectrum $5\frac{3}{4}$ $7\frac{1}{8}$, which corresponds exactly with that of red annatto.

In all such experiments, it is requisite to use deep experiment cells (I use one $2\frac{1}{4}$ inches deep), so that the amount of the bisulphide may be large in comparison with that of the oils, since the presence of much oil causes the bands to lie nearer the blue end, and thus interferes with the production of the characteristic spectrum.

Butter.

Treating yellow butter in a somewhat similar manner, I obtained the spectrum 6 $7\frac{1}{4}$. This differs entirely from that in the case of cheese, and corresponds with the spectrum of the colour of the exterior orange portion of carrots; but I am not quite certain whether this might not be derived from carrots eaten by the cows, though I am more strongly inclined to believe that it had been artificially introduced to increase the colour of the butter.

The difference between the spectra of the above-named colours and of various others closely allied to them will be better understood from the following table. In all cases they are those of the solutions in pure bisulphide of carbon:—

Red annatto	$5\frac{3}{4}$	$7\frac{1}{8}$	
Exterior of carrot and the skins of several kinds of fruit	6	$7\frac{1}{2}$	
Xanthophyll of many yellow leaves and flowers, and of the interior of carrots	$6\frac{1}{2}$	8	
Colour of the petals of *Brassica* and of many other yellow flowers	$6\frac{3}{4}$	$8\frac{3}{8}$	
Orange yellow-colour of turnip roots, and of the flowers of *Eryssimum Perofskianum*	$5\frac{1}{8}$	$6\frac{3}{4}$	$8\frac{3}{8}$

It will thus be seen that these spectra differ from one another so much as clearly to show that they are due to different substances, which are often further distinguished by their different behaviour with bisulphide of carbon and alcohol, some being almost entirely, and others only very partially removed from the alcoholic solution by that reagent, so that they may be separated when two occur mixed, as is not uncommon in some leaves and flowers. By first agitating the alcoholic solution with a little bisulphide, and washing this with alcohol, one may be procured nearly pure; and then, after agitating with a second small quantity of bisulphide and removing it, the other colour may be obtained nearly pure by evaporating the alcoholic solution to dryness, and dissolving the residue in bisulphide, which leaves indissoluble any of those numerous colours soluble in water which so commonly occur in leaves, flowers, and fruits. It is now nearly two years since I determined the existence of a considerable number of distinct substances, of which at least eight have lately been described by Dr. Thudichum,* under the general name of *leuteine*. I think that this new name can only be looked upon as something like the old term *xanthophyll*, as hitherto inaccurately employed for a whole series of yellow colours, some of which correspond with some of those included under *leuteine*. If it were, thought desirable to have a generic name, the term *leuteine* might indeed be employed; but I must protest against the idea that the substances described as such by Dr. Thudichum are one single colouring matter. Some of their properties are indeed very similar, but that is often the case with those substances which give closely connected spectra, even when other facts show that they are entirely distinct, for there seems to be a sort of correlation between optical characters and chemical reactions; but this is no reason why we should confound together substances giving absorption-bands in distinctly different positions in similar solutions.

Saffron.

The adulteration of saffron with the sliced petals of the yellow crocus could easily be detected, even in a solution, by means of the remarkable spectrum of the latter, when the product of the action of bromine is deoxidised by sulphite or hyposulphite of soda. To the alcoholic solution of the colours soluble in water an aqueous solution of bromine should be added very gradually, until, after having become quite pale, it is made slightly yellow by the addition of more. Excess of ammonia and a little sulphite of soda should then be added. In the case of pure saffron the liquid remains almost or quite colourless, whereas ammonia first turns the colouring matter of the crocus to a red, which soon becomes yellow, and then sulphite of soda changes it to a remarkably fine red, which is highly fluorescent or red-orange colour, the spectrum showing a bright narrow band at about $3\frac{1}{4}$. That of the transmitted light is very characteristic, and shows an excellent absorption band at $4\frac{3}{8}$. On adding citric acid

* *Proceedings of the Royal Society*, vol. xvii., p. 253, January, 1869.

the colour becomes red-pink; it is still highly fluorescent, but of more yellow tint than before, the bright band being raised to about 4, and the absorption band in the spectrum of the transmitted light is raised to $5\frac{1}{8}$: but the addition of hydrochloric acid destroys both the fluorescence and the absorption band. The only colour that I have met with analogous to this is one which occurs in the yellow flowers of several plants allied to the common wallflower (*Cherianthus Cheiri*), but the bands are in distinctly different positions. The production of the fluorescent colour is apparently due in both cases to deoxidisation, for even proto-sulphate of iron has the same effect as sulphite or hyphosulphite of soda. If too much bromine be added, this change does not take place; but by a little care a small amount of the petals of the yellow crocus could be detected in a considerable quantity of saffron. The presence of safflower might be recognised by a similar process, but not so decidedly. After adding bromine and ammonia, it remains distinctly yellow, but gives no absorption band, whereas pure saffron is thereby quite decolourised.

Aloes.

I have tried a number of experiments in order to ascertain whether it would be possible to detect the adulteration of the socotrine aloes with the hæpatic, but have not yet succeeded in discovering any satisfactory method. It appears as if both contain the same general colouring matter, but the socotrine a second in addition. When ammonia is added to the alcoholic solutions, the socotrine gives a more orange colour than the hæpatic, and the green part of the spectrum is more absorbed; so that, when compared side by side, the spectra are—

Socotrine	4 ..	$6\frac{1}{2}$ – –
Hæpatic		$6\frac{3}{4}$ – –

It would, therefore, be possible to distinguish them from one another, or to detect the socotrine in the hæpatic, which is, however the reverse of what would be likely to occur, since inferior things are not often adulterated with better.

Adulterations by means of Cochineal and Magenta.

Cochineal may be best detected in the tincture of roses by adding to the aqueous solution bicarbonate of ammonia and sulphite of soda. This changes the colour of the pure tincture to a very pale yellow, but that adulterated with cochineal to a light red. The spectra are somewhat thus:—

Pure tincture	8 ..	9 – – 10—
Adulterated with cochineal	$3\frac{1}{4}$..	7 – – 9—

The presence of magenta might be recognised by the spectrum of the solution in its natural state. The pure tincture shows no narrow absorption band in the green, whereas magenta gives a very distinct one, situated at 5 of my scale. In the case of the syrup of damsons and similar fruits, magenta may be detected, when in very small quantity, by agitating a dilute alcoholic solution with chloroform. If so much alcohol be added as only to partially dissolve the chloroform, scarcely a trace of the magenta is left in the alcoholic solution; and the characteristic spectrum can be easily seen by examining the chloroform, which scarcely abstracts any other colour. Ammonia produces no change in a solution of magenta in dilute alcohol; but the absorption band is immediately removed by a mere trace of sulphite of soda.

It would scarcely be a correct description of the facts to say that cochineal may easily be *detected* in pink-coloured confectionery, since, in some cases, its spectrum is seen to almost as great advantage as in any condition without any preparation, and it could generally be recognised with very little manipulation.

No doubt many other applications of methods similar to those I have described would present themselves to any one engaged in technical inquiries. I do not for one moment pretend to have exhausted the subject. I have merely examined various questions in order ascertain what methods might be employed with advantage; and I trust that the cases described above will, at all events, facilitate the application of this kind of qualitative analysis to practical questions; for I have met with many who were anxious to employ it, but had not sufficient time at command to make the preliminary experiments, which are so very necessary in all such inquiries.

NOTE ON THE AMERICAN ECLIPSE.

Dr. Morton, Professor of Chemistry in the University of Pennsylvania, has kindly forwarded me photographs of the phenomena of totality. By combining in the stereoscope pairs of these, separated by intervals of about half a minute of time, the black globe of the moon appears projected far in front of the luminous prominences and the corona, which are, therefore, clearly seen to belong to the sun. Glass transparencies from negatives specially selected for this purpose, and appropriately mounted, would show these phenomena in a very striking manner.

William Crookes.

ELECTRICITY IN PLANTS.

BY EDWIN SMITH, M.A.

There is a very interesting chapter in Becquerel's smaller treatise (in three volumes) on "Electricity and Magnetism" concerning the electrical phenomena of plants. I was induced, by reading this chapter, to make a series of experiments, with a view to illustrate the author's statements, and, if possible, to throw some fresh light upon an obscure and puzzling subject. I am now going to put together some notes of these experiments, carefully made at the time, in the hope that they may not be without a certain interest to others. The galvanometer employed is a home-made one, but tolerably sensitive. My greatest difficulty has been to depolarise the slips of platinum by means of which I have made the voltaic circuits; but every care has been taken, to the best of my ability, to obviate error arising from this cause, as well as from thermo-electric disturbance.

Experiment 1.—Take the thick, juicy leaf-stalk of the common garden rhubarb, and, having cut off a length of from 4 to 18 inches, apply a square of platinum foil to each end of the piece. Connect, by means of platinum wire, these two plates with opposite terminals of the galvanometer. The needle will be powerfully deflected. Now reverse the position of the rhubarb between its platinum surfaces, connect as before, and the needle will again be deflected, but in an opposite direction. Having previously ascertained how to interpret the movements of the needle, by noticing its behaviour when a voltaic current is produced between zinc and diluted acid, with platinum for negative plate, and transmitted through the coil, you will at once conclude that a current of electricity is passing from that end of the leaf-stalk nearest the root towards the opposite end, nearest the blade of the leaf.

Experiment 2.—Cut off a piece about 3 inches long

from the thickest part of the same leaf-stalk. Divide it longitudinally down the middle. Pare off a level slice of the outer cuticle. Lay the platinum slips close to the two flat sides thus provided, and connect with the galvanometer. There will be indicated a current from the outer side nearest the cuticle to the inner axis of the leaf-stalk. If the section is made thinner, there will be a current in the same direction. You may confirm your conclusion, as before, by simply turning over the piece of rhubarb, so as to reverse the current. Experiments 1 and 2 may be tried upon a thick midrib or branch of the same, taken from the leaf-blade, with a precisely similar result. A cucumber acts in the same way.

Experiment 3.—Insert a platinum wire into the lower end of the flower-stalk of peony. Apply foil to one of the large bracts, or to a petal; connect, and observe deflection. A current is detected flowing from the lower end of the flower-stalk to the bract or petal. The same experiment may be tried with a sprig of fresh oak-leaves, or bramble, or chickweed, or bunch of elder-buds, or poppy-flower, or stalk and leaves of poppy. The current always sets from the point nearest to the root towards the organs furthest from the root. If wires be inserted in the pistil of a flower and its stalk, there will be shown a current flowing towards the former.

Experiment 4.—Lay a leaf of the common dock between pieces of platinum foil. Connect the different surfaces with opposite terminals of the galvanometer, and notice the deflection. A current is indicated from the upper to the under surface of the leaf. A leaf of Spanish chestnut or of young elder will give the same result; but, in four experiments on a leaf of sycamore, I got a current from the under to the upper surface, after a momentary current in an opposite direction. I infer, however, that the momentary current was the true one, and that the second arose from polarisation; for I obtained this latter current by merely employing filter-paper dipped in distilled water, and laid between the slips of foil.

Experiment 5.—Twist a piece of wire round the outer cuticle of a young twig of hawthorn. Insert a second wire between the bark and wood, so as to touch the layer of cambium. On completing the circuit, a current will be indicated from the cambium to the outer cuticle. Again: pass a wire into the pith, and a current may be detected taking a direction from the cambium to the pith. Instead of hawthorn, a cutting from a fresh branch of elder, laurel, hedge-mustard, thistle, groundsel, yarrow, or other dicotyledonous plant, may be employed, with, as I have uniformly found, the same effect.

Experiment 6.—Scrape off the outer cuticle of the root of cress. By means of wires, as before, test the direction of the electric currents. They will be found to flow from the outside to the axis of the root, and, again, from the root-stock, or point of junction with the stem, towards the lower tapering end. The same effects are exhibited by the root of cat's-ear, or of thistle. If plates of platinum foil are applied to the flat surfaces made by cutting across the thick and thin ends of a carrot, a current will be found to set from the thick end of this root to the smaller end.

Experiment 7.—Take a bunch of the seeds of sycamore. Dip a samara attached to the stalk near its broader end into one of the mercury-cups, and a samara attached to the stalk at a point nearer the smaller end into the other cup. A current is indicated from the former towards the latter, in strict analogy to what happened in the third experiment. Or a piece of the stalk itself may be bent, and its ends dipped into the mercury-cups. A current will be indicated, having the same direction as before. A cutting from any pliable stem may be tried in this way, and always, so far as my experience goes, with a similar result.

Experiment 8.—Pass a platinum wire through the tubular hollow of a stem of *Poa*, or some other meadow-grass. Twist another platinum wire round the outside, and connect both with the galvanometer. A current will be shown, having a direction from the interior to the exterior surface of the stem in question. Such appears to be the law with the stems of monocotyledonous plants.

Experiment 9.—Make two cuts through a raw potato, one through the centre, another near the outer coat. Apply strips of platinum to the two flat surfaces, and connect with opposite terminals of the galvanometer. A current is shown to be passing from the centre towards the outside. A lemon, treated in the same way, furnished a current from the outside towards the centre. With a turnip, a gooseberry, and a pear, the same result was obtained; but a stalk of asparagus followed the law of the potato. A boiled potato, tested, when cold, by the same method, gave a current from the outside towards the centre, the indication being confirmed by a reversal of the slice between the platinum conductors. But, after moistening a fresh piece of boiled potato with distilled water, a current was obtained from the centre towards the outside—a result confirmed by reversing the position of the slice between the platinum conductors, as in the previous trial. Fresh platinum was employed, to obviate, as far as possible, any error from polarisation.

Experiment 10.—Reduce to a pulp with distilled water some of the meal nearest the coat of a baked potato. Then make a similar pulp of some of the meal at the centre. Having placed a plug of tow at the bend of a U-tube, pour the pulps thus prepared into different limbs. Connect, by slips and wires of platinum, with the galvanometer. In my experiment, a current was indicated from the outer pulp towards the inner pulp, agreeably to the result of my first experiment with a slice of boiled potato. My object was to destroy all vitality in the tuber by boiling or baking, and to see whether any chemical action might still remain—sufficient to cause a voltaic current when meal from different parts of the potato was made to furnish a voltaic couple.

Experiment 11.—Having procured a garden nasturtium growing in a flower-pot, insert a wire in the fleshy stem, a few inches above the soil. Then thrust a second wire through the small hole at the bottom of the pot into the soil. Connect with galvanometer. The needle is so deflected as to indicate the passing of a current from the plant to the soil in which it grows. Watering the soil made no change in the direction of the current when I performed the experiment. I also stuck the first wire into the stem in various ways and in various parts, always with the same results. At the same time, a current was detected passing from the root end towards the leaf end of the stem, conformably to the rule in other cases.

Experiment 12.—Make a solution of oxygen in distilled water, also a solution of carbonic acid. Pour them into the different limbs of a U-tube furnished with a plug of tow. Insert platinum slips, and connect with galvanometer. There will be a marked deflection of the needle, showing the passage of an electric current from the oxygen to the carbonic acid.

Confirm the result by reversing the platinum connectors.

The foregoing series of experiments are enough to set one thinking; but I feel that it would be premature to reason upon them at present, even with the admirable clue afforded by the treatise of M. Becquerel. I should like to compare, for instance, the electrical phenomena of plants in spring and in autumn, to see how far they are affected by the condition and flow of the sap.* In a future paper, I may, perhaps, be permitted to return to the subject, and attempt some *rationale* of the curious order of facts above described.

ON THE

ESTIMATION OF IODINE AND BROMINE,

WITH SPECIAL REFERENCE TO THE

ANALYSIS OF KELP.†

BY R. R. TATLOCK, F.C.S.

The methods for the estimation of iodine and bromine in presence of chlorine that have been devised from time to time are exceedingly numerous, but, in many cases, very unsatisfactory. They generally require either extreme skill and nicety on the part of the operator (a very small error in the manipulation seriously affecting the results), or they are so tedious and inapplicable in most ordinary circumstances as to be of little value. These remarks apply specially to methods that have been described for the estimation of iodine in kelp, in which the presence of bromine is either overlooked or ignored, although its existence would render such methods totally inapplicable.

The object of the following note is to describe a method for the determination of iodine, bromine, and chlorine, in presence of each other, which I have followed for many years, and which has been perfectly successful in the analysis of kelp. It is not intended to supersede other methods, but merely to take its place along with them, its simplicity in the hands of indifferently-skilled chemists rendering it suitable for adoption in the manufacturer's laboratory, a quality which will be valued more particularly in Glasgow—the seat of the iodine manufacture; while, in point of accuracy, it leaves nothing to be desired.

The method, like that of Frederick Field (*Chemical Gazette* for 1857, No. 357), is based upon the wide difference between the equivalents of iodine, bromine, and chlorine; but the mode of procedure is totally different from that of Field, and is not open to an objection which Fresenius has taken to that gentleman's process of determining these three elements. It depends upon the displacement of iodine by bromine, and of iodine and bromine by chlorine. I shall proceed to give the method in detail before referring to its application in the analysis of kelp.

1. The solution containing the iodide, bromide, and chloride, preferably in combination with an alkali metal, is divided into three equal portions, or, at any rate, three equal portions of it are drawn off. To the one, solution of silver nitrate is added in excess, to precipitate the whole of the I, Br, and Cl. The fluid is then feebly acidified with pure nitric acid, warmed, and agitated till the precipitate settles. This is collected on a small weighed filter, washed with hot water, dried as far as possible at 212°, removed from the filter, dried perfectly by heating to incipient fusion, and weighed, the weight of the small portion adhering to the filter being added, and the weight of the whole noted as—

$$AgI+AgBr+AgCl.$$

2. Another portion of the solution is transferred to a small basin, and a quantity of pure bromine-water added. The mixture is then carefully evaporated on an open water-bath, more bromine-water being added from time to time, till the escaping vapours no longer turn starch-paper blue on a fresh addition—showing that all the liberated iodine has escaped. To ensure excess, a little more aqua-bromine is added, and the solution evaporated to complete dryness. The dry residue is then drenched with water, and the result heated till again dry: this operation is repeated two or three times, to ensure the complete expulsion of any hydrobromic acid that may have been present in the bromine-water. The residue, which now consists solely of alkaline bromide and chloride, is dissolved in water, silver nitrate added in excess, the solution acidified, and the precipitate collected and weighed in the usual way. It is noted as $AgBr+AgBr+AgCl$.

3. The last portion of the solution is brought into a small basin, and a quantity of strong chlorine-water added, to effect the liberation of the iodine and bromine. The mixture is then evaporated till all colour is gone, and some more chlorine-water added. If the solution remains colourless, the whole of the iodine and bromine has been expelled, and the alkali metal will exist entirely as chloride. The solution is then brought completely to dryness, after which it is evaporated with a few drops of water two or three times, to expel any hydrochloric or hydrobromic acid. The dry residue is dissolved in water, the solution acidified with pure nitric acid, silver nitrate added in excess as before, and the chloride of silver collected as usual. Its weight is noted as—

$$AgCl+AgCl+AgCl.$$

It is obvious that we have now data from which we can calculate the amounts of iodine, bromine, and chlorine present; for, as the equivalent of bromine is less than that of iodine, in the proportion of 80 to 127, the second precipitate, in which the iodine is replaced by bromine, must weigh proportionately less than the first; and, as the equivalent of chlorine is less than that of either iodine or bromine, in the ratio of 35·5 to 127 in the one case, and 80 in the other, the last precipitate must weigh still less than the second, and we can thus, from the observed differences, deduce the exact quantities of the three elements present.

Example:—

1. $AgI+AgBr+AgCl$ weighed 15·57
2. $AgBr+AgBr+AgCl$ " 14·69
3. $AgCl+AgCl+AgCl$ " 12·20

Then—

I.		II.		Observed difference.
15·57	—	14·69	=	0·88

Loss for 1 equiv. I.		Observed loss.		1 equiv. I.		I present.
47	:	0·88	: :	127	:	2·378

I.		III.		Observed difference.
15·57	—	12·20	=	3·37

But, as a portion of this loss is caused by the replacement of iodine by chlorine, namely,

Equiv. of I.		Loss in replacing 1 equiv. I by Cl.		I found.		Loss accounted for by I present.
127	:	91·5	: :	2·378	:	1·713

* My experiments were most of them performed last spring.

† Read before the Glasgow Philosophical Society (Chemical Section), December 6th, 1869.

Observed loss.		Loss accounted for by I present.		Difference for Br.
3·37	—	1·713	=	1·657

Loss for 1 equiv. Br.		Observed loss on account of Br.		1 equiv. Br.		Br. found.
44·5	:	1·657	: :	80	:	2·978

Then, as the proportion of iodine and bromine are already known, it will be an easy matter to calculate them to iodide and bromide of silver, and deduct their weight from precipitate 1, calculating the remainder (chloride of silver) to chlorine thus :—

I.		AgI.		I present.		AgI.
127	:	235	: :	2·378	:	4·400

And—

Br.		AgBr.		Br. present.		AgBr.
80	:	188	: :	2·978	:	6·998

Then—

AgI	4·400
AgBr	6·998
	11·398

Then—

$$15·57 - 11·398 = 4·172$$

Then—

AgCl.		Cl.		AgCl.		Cl.
143·5	:	35·5	: :	4·172	:	1·032

We had, therefore, present in the solution—

Iodine	2·378
Bromine	2·978
Chlorine	1·032

The bromine water may be easily obtained free from chlorine by distilling bromide of potassium in solution with less potassium dichromate than is necessary to expel the whole of the bromine, using, of course, a little hydrochloric acid.

We now come to the application of the above method to the analysis of kelp.

It is quite obvious that this process cannot be directly applied to substances containing I, Br, and Cl, in very different proportions, and consequently it cannot be used for the estimation of these elements in kelp immediately. The following method of treatment will be found to equalise as nearly as necessary the proportions of the three :—

2000 grs. of the kelp are digested in hot water, the solution allowed to settle, and the clear liquor filtered. The residue is boiled two or three times with water, the fluid being filtered in each case, and the residue finally brought on a filter and washed with boiling water. The filtrates and washings are neutralised as nearly as possible with hydrochloric acid, and chlorine gas passed into the solution till the latter becomes of a distinct orange colour, due to the liberation of iodine and bromine.

The fluid is then shaken up with about one-fourth of its bulk of carbonic sulphide, which takes up the liberated iodine and bromine, and carries them in solution to the bottom of the vessel, provided the specific gravity of the kelp solution be not higher than that of the carbonic sulphide. When this is not the case, the solution of kelp may be diluted till the carbonic sulphide sinks.

The bottom fluid, containing the iodine and bromine, is then drawn off by a fine syphon, and shaken up with an equal volume of water and some zinc-filings. The solution is soon decolourised, on account of the formation of zinc iodide and zinc bromide, which pass into the water; and we have thus a watery solution of the two latter salts above, and colourless carbonic sulphide at the bottom. The latter is drawn off by a syphon, and restored to the kelp solution, to which some more chlorine-water is added; and, if a further quantity of iodine and bromine be liberated, the above operations are repeated till the liquor is quite exhausted.

It only now remains to evaporate the solution of zinc salts, divide into three equal portions, and determine I, Br, and Cl as before described.

With regard to the accuracy of the above method, it may be stated that two sets of trials on pure salts gave the following results, 5 grs. of each of the compounds being used in each case :—

Five grs. KI, 5 grs. KBr, and 5 grs. KCl gave—

	grains.
KI	4·97
KBr	4·97
KCl	5·08

Another trial, with the same quantities, gave—

KI	4·96
KBr	4·95
KCl	5·09

These results leave little doubt that the process is accurate and trustworthy, although I do not deny that other experiments are required to establish the method.

ON THE

CONSTITUTION OF THE COMPOUNDS OF SODIUM.

BY J. ALFRED WANKLYN, F.C.S.

Some degree of astonishment was expressed when, having discovered that ethylate of sodium and acetic ether give alcohol and an isomer of butyrate of soda, exhibiting a cleavage into alcohol and acetic acid, I did not follow the usual practice of regarding sodium as monatomic, but formulated the new compound as containing a triatomic metal. One of my chemical friends, who appeared to be unable to contain himself, pointed out to the Chemical Society of Berlin that my new compounds could be represented in the ordinary way, and, in accordance with this notion, formulated them as compounds of sodinated-ethyl, wherein the metal, regarded as monatomic, had replaced an equivalent of the hydrogen which, in union with carbon, constituted ethyl in the original compound.

I will, on the present occasion, adduce a reason which will be regarded as decisive against the ordinary formula. If the new compound were really a salt of sodinated-ethyl, it should admit of the replacement of its sodium by ethyl, and, as the result of such an operation, should give acetate of ethylated-ethyl (*i.e.* acetate of butyl). Now, nothing of the sort takes place. Iodide of ethyl, which is the proper reagent for effecting such replacements, does not produce iodide of sodium and acetate of butyl when it is made to act on my new isomer of butyrate of soda. Neither does the "absolute ethylate of sodium" (which my Berlin friend would write as hydrate of sodinated-ethyl) produce butylic alcohol by a similar treatment. The absence of such transformations and the actual course taken by the action of the iodide of ethyl on these substances, are, to my mind, conclusive against the formulæ which my chemical friends wanted me to assign to the new isomers of the sodium salts of the fatty acids.

Furthermore, I am unacquainted with any really cogent reason for assigning to sodium a mono-valent

function, even in the common, every-day sodium compounds. As yet, no vapour density determination has been made of any compound of sodium. Some nine or ten years ago, in a paper urging the di-valent nature of zinc and mercury, I pointed out that no metallic chloride, or other metallic compound, had been shown to present only one atom of chlorine or other representative of hydrogen in the standard, two volumes constituting the vapour-unit to which vapour densities are referred. The same remark holds good to-day; and, most probably, when chemists have taken the vapour density of common salt, there will be found two atoms of chlorine in the vapour unit.

The facts of the evolution of hydrogen when sodium acts upon water, of double decompositions taking place between salts of sodium and salts of other metals, are not more in accordance with the view that the metal is mono-valent than with other views.

On the other hand, the researches in which I have been engaged have constantly exhibited the polyvalency of sodium. I do not know any chemical compound which shows a greater tendency to enter into double compounds than does absolute ethylate of sodium. With HCl, C_2H_3OCl, H_2S, and C_2H_6O, it forms double compounds. With CO_2, it combines, forming a double compound. With NH_3 and CO, there is no action at all, even at 200° C.—neither combination nor reaction to yield separated products. Iodide of ethyl alone (and even this is a doubtful point) may possibly react without preliminary formation of a double compound.

Now, this constant tendency to form doubles is the criterion of polyvalency. Oxygen was regarded as divalent mainly because there are double oxides of the alcohol radicles and no corresponding double chlorides.

The following is a list of compounds wherein the trivalent character of the metal is apparent:—

1. Double compound of sodium-ethyl and zinc-ethyl..... $Na'''\left\{\begin{matrix}(ZnC_2H_5)'\\C_2H_5\\C_2H_5\end{matrix}\right.$
2. Sodium-triacetyl..... $Na'''\left\{\begin{matrix}C_2H_3O\\C_2H_3O\\C_2H_3O\end{matrix}\right.$
3. Absolute ethylate of sodium..... $Na'''\left\{\begin{matrix}O\\H\end{matrix}\right\}C_2H_4$
4. Double compound of absolute ethylate with hydrochloric acid $Na'''\left\{\begin{matrix}(OC_2H_5)'\\H\\Cl\end{matrix}\right.$
5. Double compound of absolute ethylate with sulphuretted hydrogen ..... $Na'''\left\{\begin{matrix}(OC_2H_5)'\\H\\(SH)'\end{matrix}\right.$
6. Double compound with chloride of acetyl..... $Na'''\left\{\begin{matrix}(OC_2H_5)'\\C_2H_3O\\Cl\end{matrix}\right.$
7. Acetate of ethylene-sodium..... $Na'''\left\{\begin{matrix}O\\C_2H_3O\end{matrix}\right\}C_2H_4$
8. Valerianate of ethylene-sodium .... $Na'''\left\{\begin{matrix}O\\C_5H_9O\end{matrix}\right\}C_2H_4$
9. Benzoate of ethylene-sodium ..... $Na'''\left\{\begin{matrix}O\\C_7H_5O\end{matrix}\right\}C_2H_4$
10. Absolute amylate of sodium ..... $Na'''\left\{\begin{matrix}O\\H\end{matrix}\right\}C_5H_{10}$
11. Acetate of amylene-sodium ..... $Na'''\left\{\begin{matrix}O\\C_2H_3O\end{matrix}\right\}C_5H_{10}$
12. Valerianate of amylene-sodium.... $Na'''\left\{\begin{matrix}O\\C_5H_9O\end{matrix}\right\}C_5H_{10}$

All of these bodies have been actually obtained, and will be found mentioned in my papers. In order to form an adequate idea of the numerical strength of this material, it should be borne in mind that the examples on the above list have, to a great extent, the character of typical cases. Thus Nos. 7, 8, 9, 11, and 12 are members of one class whose numbers are very moderately computed at ten thousand. And it should, also, not be forgotten that there has, as yet, been no general movement among chemists in search of double sodium compounds, but that search has been confined to one solitary chemist.

It will be observed that, although I continue to look upon sodium as tri-valent, yet that some alteration has been made in the formulæ of absolute ethylate of sodium, and of the isomers of the sodium-salts of the fatty acid. At first, I wrote—

$$Na'''\left\{\begin{matrix}(C_2H_4)''\\OH\end{matrix}\right.$$

now I have transferred the oxygen from the hydrogen to the ethylene, and, in place of regarding sodium as two-thirds saturated with ethylene and one-third with hydroxyl, I now regard sodium as one-third saturated with oxygen, one-third with ethylene, and one-third with hydrogen.

Adopting this modification of the formulæ, the various metamorphoses of the compounds may be exhibited with great simplicity and regularity. In particular, the reaction between iodide of ethyl and acetate of ethylene sodium (at first sight one of formidable complication) becomes regular and intelligible when viewed in the light of the new formulæ; it consists in the production of iodide of sodium, alcohol, and caproate of acetylinated ethyl:—

$$Na'''\left\{\begin{matrix}OC_2H_4\\|\\(C_2H_3O)\end{matrix}\right\}Na'''\left\{\begin{matrix}OC_2H_4\\|\\(C_2H_3O)\end{matrix}\right\}+{}_2C_2H_5I=$$
$$=Na_2I_2+\left\{\begin{matrix}C_2H(C_2H_5)_2O\\|\\OC_2H_4(O_2H_3C)\end{matrix}\right\}+OC_2H_4H_2.$$

In the above list, sodium has always been written as tri-valent; it is, however, right to add that I am prepared to consider the metal as being five-valent in the double compounds of ethylate of sodium with hydrochloric acid, sulphuretted hydrogen, and chloride of acetyl. I have, on other occasions, contended that sodium is seven-valent in the crystalline compound of the ethylate with three molecules of alcohol. As will be gathered from my various papers on this subject, I regard sodium as never *mono-valent*, but as tri-, five-, seven-valent, and perhaps even higher. This paper has been restricted to organic compounds; on another occasion, I propose to exhibit the inorganic compounds of sodium in a new light.

II.

In this paper I propose to consider the function of sodium in the common compounds of the metal, and to enquire how far the ideas derived from the study of its organic compounds mentioned in the former paper are applicable to its common, well-known inorganic compounds.

Viewed in these organic compounds, sodium appeared as the representative—not of hydrogen, but of nitrogen; the task before me is, therefore, to represent,

if possible, the inorganic sodium compounds as modelled on the plan of the compounds of nitrogen.

As I have already stated on various occasions, common salt admits of being looked upon as a sodium compound of the second order of complexity, thus:—

$$Cl\,Na''' \overline{\overline{\quad}} Na'''\,Cl$$

and obviously a similar device might be applied to other well-known sodium compounds, such as the numerous soda salts.

I do not, however, propose to avail myself largely of a hypothesis of this kind on the present occasion, and am able to represent the metal as *unduplicated*, and, at the same time, trivalent in most of the compounds in question.

The following list of formulæ will speak for itself:—

Caustic soda	Na'''	$\left\{\begin{matrix}O''\\H\end{matrix}\right.$
Nitrate of soda	Na'''	$\left\{\begin{matrix}O''\\(NO_2)'\end{matrix}\right.$
Acetate of soda....	Na'''	$\left\{\begin{matrix}O''\\(C_2H_3O)'\end{matrix}\right.$
Sulphate of soda..	Na'''	$\left\{\begin{matrix}O'' \quad O''\\ -(SO_2)''-\end{matrix}\right\} Na'''$
Acid sulphate of soda.....	Na'''	$\left\{\begin{matrix}O''\\ -(SO_2'')-(OH)\end{matrix}\right.$
Bleaching soda.....	Na'''	$\left\{\begin{matrix}(OCl)'\\Cl\\H\end{matrix}\right.$
Hypochlorite of soda	Na'''	$\left\{\begin{matrix}O''\\Cl\end{matrix}\right.$
Sulphuretted soda	Na'''	$\left\{\begin{matrix}S''\\H\end{matrix}\right.$
Common salt.....	Na'''	$\left\{\begin{matrix}Cl \quad Cl\\ \overline{\overline{\quad}}\end{matrix}\right\} Na'''$, or Na_2Cl_2
Anhydrous oxide of sodium	Na'''	$\left\{\begin{matrix}-O-\\ \overline{\overline{\quad}}\end{matrix}\right\} Na'''$, or Na_2O
Sulphuret of sodium	Na'''	$\left\{\begin{matrix}-S-\\ \overline{\overline{\quad}}\end{matrix}\right\} Na'''$, or Na_2S
Bromide of sodium.	Na'''	$\left\{\begin{matrix}Br \quad Br\\ \overline{\overline{\quad}}\end{matrix}\right\} Na'''$, or Na_2Br_2
Iodide of sodium...	Na'''	$\left\{\begin{matrix}I \quad I\\ \overline{\overline{\quad}}\end{matrix}\right\} Na'''$, or Na_2I_2
Amide of sodium...	Na'''	$\left\{\begin{matrix}(NH)''\\H\end{matrix}\right.$
Nitride of sodium...	$(Na_3)'''N'''$	

The list might be indefinitely extended, so as to exhibit the constitution of a host of double chlorides, bromides, and iodides. I will, however, content myself with formulating the Nessler reagent:—

$$Na''' \left\{\begin{matrix}(HgI)'\\I\\I\end{matrix}\right.$$

and will leave the rest to the imagination of my readers, who will find no difficulty in comprehending that to the new theory belongs the merit of rendering account of the vast number of double haloid compounds containing the alkali metals, which, according to the prevalent notion that the alkali metals are analogues of hydrogen, are regarded as mere freaks of nature, and as much as possible put out of sight.

Reverting to the new formula for caustic soda:—

The fact that caustic soda is volatile is an argument in favour of taking a single rather than a duplicate formula for that substance. (Possibly it will be found that when chloride of sodium seems to volatilise it really undergoes change into trichloride of sodium and metallic sodium—a view which is in harmony with various facts, notably, with the extraordinary power of chlorine to facilitate the volatilisation of metallic chlorides.)

According to the new theory, the action of sodium on water is as follows:—

$$Na''' + \left\{\begin{matrix}H\\H\end{matrix}\right\}O = HNa'''\left\{\begin{matrix}O\\\end{matrix}\right. + H$$

According to the theory at present in vogue, this reaction is thus:—

$$Na' + \left\{\begin{matrix}H\\H\end{matrix}\right\}O = \begin{matrix}H\\Na'\end{matrix}\left\{\begin{matrix}O\\\end{matrix}\right. + H$$

The new theory, therefore, represents sodium as doing more than twice the amount of chemical work that is done by the metal according to the old theory. Instead of displacing one atom of hydrogen, sodium really displaces two atoms of hydrogen, and also combines with one of the displaced atoms. Hence the extraordinary quantity of heat generated by the action of alkali metals on water.

The ordinary theory of caustic soda, as a member of the water-type, is beset with difficulties and inconsistencies of many kinds. Why should caustic soda be so active a chemical reagent as it is? If alcohol and caustic soda be both of them built on the water-type, why should the former be so inactive and the latter so very active.

The new theory renders account of the energy of caustic soda. According to it this substance is, in one-third of its structure, the hydride of sodium, and, therefore, naturally endowed with abounding energy.

Berthelot's splendid discovery of the synthesis of formiate of soda is beautifully in harmony with the new theory:—

$$CO + Na'''\left\{\begin{matrix}O''\\H\end{matrix}\right. = Na'''\left\{\begin{matrix}O''\\COH\end{matrix}\right.$$

The production of bleaching soda, and, generally, oxidation under the influence of alkalies, are quite natural changes suggested by the very formulæ of the new theory:—

$$Cl_2 + Na'''\left\{\begin{matrix}O''\\H\end{matrix}\right. = Na\left\{\begin{matrix}Cl\\(OCl)'\\H\end{matrix}\right.$$

London, Dec. 24, 1869.

ON THE

ESTIMATION OF PEROXIDE OF MANGANESE IN MANGANESE ORES.

BY E. SHERER AND G. RUMPF.

The method of Fresenius and Will for the estimation of manganese, to which for so long preference has been given, has recently been objected to in England by the consumers of the ore. Attention has been called to the fact that this method shows, indeed, correctly the proportion of binoxide of manganese in the sample, but, on the other hand, does not represent its value as an agent for the production of chlorine.

The reason for this is that metallic iron or its protocompounds, which are often present in the ore, absorb oxygen to form a sesqui salt when the sample is treated with hydrochloric acid, but remain unchanged when it is treated with concentrated sulphuric acid and oxalate of soda.

In consequence of this, the method of Fresenius and Will is still used in some laboratories, while, in

others, it has been superseded by the iron method; from which circumstance an uncertainty in the valuation of the article arises, disagreeable alike to purchasers and sellers.

This has led us to subject the various methods to a careful examination and comparison one with another. Our object was to ascertain, by a series of experiments, how far the estimations by the same method agreed one with another, and then to discover the causes of the differences that have been observed between the results obtained by the different methods.

A sample of American manganese was used for our experiments. A large quantity was pounded, well mixed, and carefully dried at 100° C. The moisture amounted to 0·749 per cent. Quantities of the dry manganese were then at once weighed off for the various tests.

I. *According to the Method of Fresenius and Will.*

Years of experience having proved to us the constancy of results obtained by this method, we considered that three trials would be sufficient. These served to show the actual amount of binoxide in the sample.

1. 2·1098 grms. manganese caused the evolution of 1·355 grms. carbonic acid = 63·49 per cent.

2. 1·5103 grms. manganese caused the evolution of 0·970 grms. carbonic acid = 63·49 per cent.

3. 1·3645 grms. manganese caused the evolution of 0·8770 grms. carbonic acid = 63·53 per cent.

II. *According to the Iron Method.*

The estimations by this process were conducted in the following manner :—

A weighed quantity of pianoforte-wire was dissolved in hydrochloric acid, in a glass flask. Carbonic acid was conducted into the flask during the operation, to prevent the oxidation of the protochloride of iron produced by oxygen from the atmosphere. When complete solution had taken place, a small tube, containing an accurately-weighed quantity of the manganese, was dropped into the flask, the mixture boiled until complete decomposition had taken place, and then cooled in the stream of carbonic acid. The excess of the protochloride was then estimated in the usual way, by means of a standard solution of bichromate of potash. The weight of the iron wire, multiplied by 0·997, was taken as the amount of pure iron used.

1.	0·8748 grms. manganese	Chromate of potash used,	
	1·0796 " pure iron	22·7 c.c. = 62·00 per cent.	
2.	0·7504 " manganese	Chromate of potash used,	
	1·03668 " pure iron	25·85 c.c. = 62·35 per cent.	
3.	0·8746 " manganese	Chromate of potash used,	
	1·1686 " pure iron	27·65 c.c. = 62·54 per cent.	
4.	0·7604 " manganese	Chromate of potash used,	
	0·9692 " pure iron	21·45 c.c. = 62·20 per cent.	
5	0·9312 " manganese	Chromate of potash used,	
	1·3846 " pure iron	38·2 c.c. = 61·97 per cent.	
6.	0·5467 " manganese	Chromate of potash used,	
	1·2183 " pure iron	46·8 c.c. = 61·39 per cent.	
7.	1·135 " manganese	Chromate of potash used,	
	1·0787 " pure iron	10·2 c.c. = 62·07 per cent.	
8.	1·0446 " manganese	Chromate of potash used,	
	1·0792 " pure iron	14·6 c.c. = 62·01 per cent.	

We therefore conclude, from these figures, that this method, proceeded with in the way we have described, does not yield accurate results.

III. *The Estimation of Manganese by the Formation of Chloride of Lime.*

The advantage that this method would seem to have over all others is that the manganese is treated in precisely the same manner in the laboratory as it is on the large scale in the manufacture of bleaching-powder.

Weighed quantities of the sample were treated with strong hydrochloric acid in a small flask until complete decomposition had taken place. The chlorine produced was conducted first into another flask, and then into a U-tube, both of which were filled with a weak milk of lime. The resulting chloride of lime was then tested by Gay Lussac's method, with arsenious acid.

			AsO_3. c.c.	per cent.
(1).	1·0561 grms.	manganese	53·90	= 62·60
(2).	1·0845 "	"	56·05	= 63·39
(3).	1·2045 "	"	61·70	= 62·83
(4).	0·4222 "	"	20·70	= 60·14
(5).	0·8102 "	"	39 75	= 60·18
(6).	0·4929 "	"	23·15	= 59·06
(7).	0·4875 "	"	23·15	= 58·15

These figures sufficiently prove that no accurate results are to be obtained by this method.

We next experimented on Bunsen's method.

Weighed quantities of manganese were dissolved in hydrochloric acid in the same manner as in the preceding. The escaping chlorine was received in a strong solution of iodide of potassium, and the liberated iodine subsequently estimated by means of a standard solution of hyposulphite of soda and a solution of starch. To prevent the solution of iodide of potassium from being sucked back into the generating-flask, a few small pieces of magnesite were introduced with the manganese, so that a continual slight escape of carbonic acid took place through the solution.

The solution of hyposulphite of soda was proved by means of a carefully-prepared pure iodine. 3·0436 grms. were dissolved in iodide of potassium, and diluted to 250 c.c. 10 c.c. of this solution required 17·90 c.c. of the hyposulphite of soda solution. 1000 c.c. of hyposulphite of soda solution would, therefore, correspond to 2·3294 grms. of binoxide of manganese. A second trial, in which 2·4767 grms. of the pure iodine were used, 1000 c.c. of the hyposulphite were found to correspond to 2·3319 grs. of binoxide of manganese, which two results closely agree. In testing the manganese—

			NaO,S_2O_2. c.c.	per cent.
(1).	0·6472 grs.	manganese	35·8	= 62·76
(2).	0·6427 "	"	34·6	= 62·73
(3).	0·6035 "	"	32·5	= 62·73

These results agreed so closely that we considered further estimations by this method to be quite unnecessary.

If we now compare the various results, we see that the sample, according to the method of—

	Average. per cent.	Greatest difference. per cent.
Fresenius and Will showed	63·50	0·04
Iron method showed	62·06	1·15
Chloride of lime estimation showed	60·90	5·24
Bunsen's method showed	62·74	0·03

From this, we see that only the methods of Fresenius and Will, and that of Bunsen, give constant results; and, of these two, the latter-named undoubtedly represented the value of the ore as an agent for the pro-

duction of chlorine, since only the chlorine evolved from the sample in the form of gas is estimated. We therefore may conclude that the method of Fresenius and Will gives results too high, while the iron and chloride of lime methods give results much too low. Our next step was to discover the reason for these differences. The cause of the high result obtained by the method of Fresenius and Will has already been mentioned at the commencement of this paper. We did not consider it necessary to examine whether or no the sample on which we were operating actually contained iron or its proto-compounds. The object we had in view was a purely practical one; and the possibility of the presence of such iron compounds in the ore cannot be disputed. The following experiment proves that a very considerable addition of metallic iron will not in the slightest degree affect the accuracy of the results obtained by this method. 1·4706 grms. of metallic iron were added to 2·4745 grms. of the manganese, concentrated sulphuric acid added, and the test proceeded with as usual. The result obtained—viz., 63·13 per cent—differed only by 0·37 per cent from the average of the three previous trials made by this method, notwithstanding that the amount of iron added was sufficient to render three-quarters of the manganese unavailable as an oxidising agent when dissolved in hydrochloric acid. Since varieties of manganese ore do contain the iron compounds of which we have spoken, we did not further investigate the question whether or no this was the only cause of the two high results which this method yields under certain circumstances. The reason of the uncertainty of the results obtained by the iron method, as, also, of their being generally too low, we discovered to be, that a slight loss of chlorine generally takes place during the operation. When the manganese is added to the protochloride solution, a greater or less quantity frequently floats on the surface of the liquid for a short time. A small quantity of chlorine is evolved from this, which has no opportunity of acting on the iron solution, and is carried off with the stream of carbonic acid. We convinced ourselves that this was the case by conducting the escaping gas into a second flask, which contained a small quantity of weak protochloride of iron solution. As soon as the manganese rose to the surface of the liquid in the decomposing-flask, a yellow color appeared in the liquid in the second flask, proving that a portion of the chlorine from the manganese escaped into the second flask, and there formed a sesquichloride of iron. The contents of the two flasks were then separately tested with the chromate of potash solution. From the first flask alone, the sample would seem to contain 2 per cent less than it actually does contain.

0·8129 grms. manganese.	
1·06519 grms. pure iron in first flask.	
25·8 c.c. chromate of potash used for first flask	60·48 per cent
0·989 grms. pure iron in second flask	
57·02 c.c. chromate of potash used for second flask	1·99 per cent
	62·47 per cent

This figure agrees tolerably well with the result obtained by Bunsen's method. This method can, therefore, be made to yield accurate results, but only by a difficult and troublesome arrangement, which makes it more complicated and longer than that of Bunsen. Instead of metallic iron, a proto-salt—such as the double sulphate of iron and ammonia—is sometimes used in the iron process, and the decomposition of the manganese effected by means of weak sulphuric acid. No loss of gas probably takes place in this method. Experience has shown us that it is very difficult to obtain such salts perfectly free both from sesqui-compounds of iron and moisture. We did not, therefore, experiment on this method.

The reason of the great irregularity in the results obtained by the chloride of lime methodis easily perceived. At 40° C., chloride of lime commences to be decomposed into chlorate of lime; so that a greater or less speed in the evolution of the gas will produce a greater or less warmth in the milk of lime, and, consequently, more or less decompose it. We endeavoured, by external cooling, to prevent this warming and decomposition, but with no satisfactory results, as the following figures will show. The milk of lime was cooled by the external application of a mixture of sulphate of soda and hydrochloric acid.

		AsO3. c.c.	per cent.
(1).	0·3633 grms. manganese	18·90	= 63·80
(2).	0·7778 " "	38·45	= 60·64
(3).	0·8185 " "	40·50	= 60·70
(4).	0·9204 " "	46·25	= 61·64
(5).	0·6975 " "	35·65	= 62·69
(6).	0·5581 " "	26·85	= 59·01

This method can, therefore, only be used for approximate results.

In estimating the manganese by the method of Bunsen, the iodine liberated by the chlorine should be tested as soon as possible after the decomposition. The iodine solution from the tests numbered 1 and 2 were again tested after standing twenty-four hours. The results were both over 65 per cent. This was caused by the conversion of iodine into hydriodic acid. In conclusion, therefore, we may decide that the results obtained by Bunsen's method exceed all others in accuracy. Its simplicity, also, is greater than that of the iron method, as it requires only one weighing, and does not need a stream of carbonic acid. At the mines where tests continually have to be made, the method of Fresenius and Will would certainly appear to be the best and simplest, so much the more that here no accidental admixture of iron can have taken place.

In conclusion, we would suggest that it is more reasonable to represent the value of manganese rather by chlorometrical degrees than by the percentage of binoxide. Neither the method of Bunsen nor the iron method represent the percentage of binoxide, but the relative value of the ore as an agent for the production of chlorine; and, therefore, a similar form of expression for the value of chloride of lime and manganese, seems to us desirable.

Wiesbaden, Oct. 11th, 1869.

P.S. The foregoing paper is the result of experiments made at the laboratory of Dr. R. Fresenius, in Wiesbaden.

CAUSE OF BRIGHT LINE ON PARTIAL-PHASE ECLIPSE PICTURES.*

BY PROFESSOR HENRY MORTON.

During the progress of the eclipse of August 7th, I observed on the negatives, taken during the partial phase by the section of my party with which I had located

* Communicated by the Author.

myself, a decided increase in the opacity of the silver deposit in immediate contact with the advancing edge of the moon. When, after our return to Philadelphia, all the negatives taken by the other two sections were handed over to me, I found the same characteristic appearance, varying only slightly in degree, to distinguish all of them, and this had, of course, been noticed by those engaged in making the pictures. In fact, many remarks have been made upon this point, and some deductions drawn from it.

On the paper prints prepared from these negatives this local density produced a line of light in contact with the moon's limb.

An appearance similar to this had been observed by Professor Alexander, in the photographs taken during the eclipse of 1860, as also by Mr. De la Rue, and while ascribed by Professor Challis and Professor Alexander to a very rare lunar atmosphere, had been explained by Mr. De la Rue and the Astronomer-Royal, as a subjective effect.

The Astronomer-Royal had, moreover, shown, in papers published in the *Monthly Notices* of the Royal Society, 1863, Nov. 13, and 1864, June 10, that no such effect would be produced by a lunar atmosphere, were it present. He, therefore, very justly discards such a supposition, and, by satisfactory experiments, shows that the light line in *the prints under his examination* is an optical illusion, and not an existing fact.

These experiments, however, when applied to good prints of our pictures, did not show the same result, and, beside, the actual opacity of the negatives seemed to preclude the above explanation as one accounting for the *entire* effect.

I therefore made the following experiment:—I converted one of the solar pictures, taken soon after first contact, into a crescent, by pasting partly over it a dark circular piece cut from another print. This showed a faint line of light, such as results from contrast, and which was no doubt found in the pictures examined by the Astronomer-Royal.

I then had this artificial eclipse-picture photographed (through the kindness of Mr. James Cremer), when negatives were produced showing a dense deposit along the lunar edge, and giving prints which showed a bright line in the same place, far more decided than that seen in the artificial original.

It thus appears that the effect observed in these eclipse pictures, while not due to any lunar inflection of sunlight, is also not due to an optical effect of contrast solely, but is, in great part, due to a chemical action, which may be explained by what we know of the chemical reactions concerned in the production of a negative.

It is well known that the development of a negative depends upon the presence of free nitrate of silver in the film, and that a great strengthening or intensifying may be produced by re-immersion in the silver bath, and a second application of the developer. Now, in the present case, part of the plate representing the dark edge of the moon, and, therefore, not acted upon, furnishes a reservoir of nitrate of silver, imbibed by the collodion film, which, during the development, penetrates for a short distance into the portion representing the *luminous* area of the sun whose supply of free nitrate was exhausted by the reaction which occurred at the first moment when the developer was applied.

My conclusion, then, is, that while a certain effect in the paper prints is, and was on former occasions, due to "contrast," yet, in the present instance, the peculiar appearance of the negatives, and most of that seen on the prints, is the result of a chemical action such as I have described, and does not represent any celestial phenomenon. The *appearance* of a bright line in the same place which has been noted by several observers is, we believe, due simply to the contrast of the sharply-defined lunar edge, which produces the faint line above mentioned, in the artificial eclipse picture before described.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

Thursday, December 2nd, 1869.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time—James Bell, Howell Hill, Ewell; G. R. Hislop, Gas Works, Paisley; William Ladd, Beak Street, Regent Street; Alfred Bird, Worcester Street, Birmingham; H. Seward, 15, Barnsbury Park, N.; Edwin Lepper, 11, Maiden Lane, Queen Street, Cheapside, E.C.

For the second time—Samuel Jefferson, Secretary to the Yorkshire Board of Education, Woodville Terrace, Woodhouse Lane, Leeds; Clements Higgins, Demonstrator of Chemistry, King's College, London; James John Bourey, Analytical Chemist, 10, Stepney Causeway, E.

For the third time—Matthew H. Cochrane, 108, Paul Terrace, Glasgow; Edward Smith, Practical and Pharmaceutical Chemist, Strand, Torquay; Thomas Walton, M.R.C.S., and L.S.A., Leeturer on Chemistry at the Hull and East Riding School of Medicine, Kingston-upon-Hull; G. Manley Hopwood, 22, Grosvenor Square, All Saints, Manchester; John Wiggin, Pharmaceutieal and Analytical Chemist, Ipswieh; Thomas Gibb, A.R.S.M., Engineer; George Harrison, Analytical Chemist, 26, Havelock Square, Sheffield; Sir Roderiek Impey Murchison, Bart., F.R.S., Belgrave Square.

The last-named gentlemen were balloted for and duly elected.

The first paper read was entitled "*Remarks on some Points in the Nomenclature of Salts*," by H. G. Madan, F.C.S.

The author calls attention to the unsettled state of chemieal nomenclature, and the diffieulty of teaching the science while hardly two of our text-books adopt the same system of names, and while specimens of so many totally different systems are to be found in our periodicals. He then refers to the terminations to the electro-negative radicles, such as *-ide*, *-ite*, and *-ate*, and suggests that the accepted prineiple of indicating the amount of oxygen in the radicle by a change of a vowel in the name might be extended, so as to embrace such substances as chlorine and sulphur, which form, with oxygen, more than two radicles.

To distinguish the several members of each group of salts containing the same electro-negative or electro-positive radicle, the author prefers rather to add a prefix, such as *proto-*, *di-*, *tri-*, *per-*, &c., to the existing generic name for the salts of the electro-negative radicle with which it is associated than to change the termination of the name of the electro-positive radicle into *-ic* or *-ous*, as the prefix requires the least alteration in existing names, and is the more elastic system of the two.

Mr. Madan does not see the advantage of calling radicles by their Latin names, such as *argentic* nitrate or *ferrous* chloride, but if such a system is considered convenient, it should be carried out consistently, by using such terms as *kalic*, *natric*, *stilbic*, *hydrargic*, &c. The system of terminology proposed by Mr. Harcourt,* and adopted by Roscoe and

* Chemical News, vol. xvi. p. 272; *Am. Repr., Jan.* 1868, *page* 28.

[English Edition, Vol. XX., No. 527, page 313; No. 524, pages 280, 281.]

Watts, is, in the opinion of the author, more simple, permanent, and yet elastic, than any other.

Professor Attfield thought the chief point about a name should be that it was unalterable. He objected to the use of vowels or of Latin or Greek numerals to express the name of a salt, as their views of the constitution of a substance sometimes changed, and when such was the case, it became necessary to alter the name.

The President said that Mr. Madan's proposal to revert to the use of such terms as *proto-*, *sesqui-*, and *per-* in order to designate the place of bodies which differ in their quantity of oxygen and chlorine in a series, implied that the series was known, whereas we are constantly altering our knowledge of such series. These words had been productive of considerable inconvenience and confusion, and he thought the terminations *-ous* and *-ic*, as used by most writers, including Mr. Roscoe and Mr. Watts, were far more convenient. These terminations only denote a kind of difference in the constitution of certain substances; such a difference might be ascertained as a matter of fact. They might find other terms of each series, and a body which was first might become second, but if it contained less oxygen than another, it was correctly distinguished by the termination *-ous* instead of *-ic*. Mr. Madan seemed to think it necessary always to retain Latin words if they were used in certain cases. It was held by some persons that a variety of name was in many cases desirable amongst such compounds as Prussian blue, where iron figured in two capacities. He, the speaker, was not aware that those who advocated the view against which Mr. Madan contended had ever asserted that a Latin name, if used at all, ought universally to be employed; and if English names were insisted on, they would be led into eccentricities not less remarkable than those against which the author contends. Carbon and sulphur were Latin words which, if discarded in favour of the English words, would lead to words like charcoalic oxide and charcoalic acid, and brimstonic acid and brimstonous acid, a change which did not appear to him a very great improvement. It was exceedingly desirable that everybody should bring forward his own impression in the matter, because it was only by general consent that any important system could be established.

Mr. Vernon Harcourt thought the difficulty attaching to the choice of names was inevitable in the present state of chemistry. Either a name must be unsystematic, and merely express one or two facts about the particular substance, *e. g.*, corrosive sublimate; or, if it was systematic, and expressed a relation between the particular substance and others, it must embody a theory not yet definitely established. With reference to English and Latin names, sulphur had for so long a time been used as an English word, that it was, in reality, no less so than brimstone. The latter, he supposed, was a German word, and sulphur was, originally, Latin, but it had now become as thoroughly English as any word in the language. With regard to using *ic* and *ous*, he thought that the terminations *proto* and *per* might equally be said to express facts; and it appeared to him that the objection raised by Mr. Madan, that the terminations *-ic* and *-ous* served only for two terms of a series, and that this mode of expression cannot be extended in cases where the series extends beyond two terms was a just one. At the same time, he thought that, where there were two parallel series of salts (such as mercurious and mercuric salts, ferrous and ferric salts), it was a great convenience to have these terms, and "ferrous salts" was, perhaps, a better expression than "iron proto-salts," which Mr. Madan recommended as a substitute.

Mr. McLeod remarked that there was a certain excuse for the use of Latin words, for, in almost all cases, they referred to the symbol.

Dr. Odling said that Mr. Madan spoke of the convenience which occasionally attached to their being able to use such a word as "proto-salts," and to speak of proto-salts in general. It would be a real advantage if all proto-salts were conceived to have the same constitution; but, as the word proto-salts did not express the constitution any more than *-ic* and *-ous*, he could not admit that argument to have any weight in favour of the use of such words as *proto-* and *per-* rather than of *-ic* and *-ous*. He was rather inclined to agree with Mr. Harcourt's observations in defence of the English. Respecting such words as mono-chloride and bi-chloride of mercury, it was quite true that, if they used them, they meant that the one contained double the quantity of chlorine in the molecule to the other, and not merely double the ratio of the mercury and the chlorine.

The President hoped it would not be understood that he insisted on Latin names in preference to the English. When Latin names were more easily modified than English, by all means use them; but, when such was not the case, refuse them. It would not be worth while to employ English words instead of the Latin aluminium, chromium, &c.; and it should not be argued that, because they used English words in some cases, that therefore they must use them in all cases. The whole genius of the English language was at variance with that proposition. They wanted an intelligible principle to guide them, instead of the fixed names, which imply particular theories of the constitution of bodies. With regard to *-ic* and *-ous* only adapting themselves to one term of a series, he conceived that, as long as they had to do with the properties of bodies in chemistry, the difference between acid and basic bodies would be one of the chief things to refer to; and, if the business of names was to recall the chief properties of bodies, he thought it must be an advantage, in describing terms of a series, to use some name to distinguish those which were not acid from those which were.

Professor Voelcker said that, in one aspect, uniformity of nomenclature had great advantages; but he was not sure that one and the same chemical compound, having two, three, or four different names, was an unmitigated evil. In teaching chemistry, he would not object to a substance being called by the empirical name, if, by this means, certain properties were fixed upon the mind of the student, by which he became familiar with a certain definite substance. He might afterwards be told to call it by another name, and then by a third; and, when he was once familiar with the real nature of the substance, it was immaterial whether he knew it by one name or the other. By the same combination having different names, the teacher would be able to illustrate the different views entertained by chemists of the constitution of a substance.

The next paper was on "*Results of the Analysis of Sea Water Performed on board H.M.S. Porcupine, July*, 1869," by John Hunter, M.A., F.C.S.

The first part of this paper is devoted to abstracts of papers published on this subject by Darondeau, Aime, Bischof, Hayes, Morren, and Thorpe, given by the author to show that very little has been done in investigating the gases contained in the ocean at any great depth, and that the various experiments had not yielded identical results. To collect the water for his experiments, the author used a large brass tube, attached to the sounding-line. Two valves were placed in the tube, one at the upper end, the other below, but both opening upwards, so that, when descending, the water flowed freely through, but, when drawn up, the pressure of the external water closed the valves, and the sample of the last water which had entered the tube was secured. 800 c.c. were placed in a flask, and the gases determined by boiling, according to the method of Dr. Miller. The amount of organic matter was observed by Dr. Miller's process, and the specific gravity was also taken. Two series of experiments were made. In the first, the specific gravity of the bottom water was rather less than that of the surface; but, in the second series, they were identical. The carbonic acid was found to be in greatest quantity at the bottom: it then diminished a certain amount, and remained pretty constant until within about 100 fathoms of the surface, when it diminished still more. The

amount of organic matter was about the same in bottom and surface water.

At the end, Mr. Hunter gives the results of his experiments in a tabulated form.

Mr. McLeod thought that, if the absolute quantity of carbonic anhydride or carbonic acid gas in 100 volumes of water had been given, the results would then have been more comparable, and the relation between sea water and ordinary spring water would be shown. The total quantity of gas in 100 volumes of sea water was much less than he would have expected, and less than is found in ordinary river waters. Thames water, he thought, contained 6 volumes in 100 of the three gases together; while the largest proportion of gas in sea water, according to Mr. Hunter, was only 2·8 in 100. It had been stated that sea water brought from a depth effervesced like soda-water; but that would seem to be almost an impossibility if the quantity of gas obtained was as low as 2·8. It was just possible that, in collecting the water, if there was any pressure in the tube, it would open the upper valve, and allow nearly all the gas to escape; but he (Mr. McLeod) was not in a position to suggest a better apparatus than the one described.

The President thought that, if it were soda-water below, they ought to cork it up before bringing it to the surface; but the results obtained by Mr. Hunter did not agree with the soda-water theory. He did not see that the gas should have any tendency to come off from the water, when there was so little of it there; but the quantities might not, perhaps, have been so great as reports made of experiments would lead one to expect.

The Society then adjourned to the 16th inst.

Thursday, December 16th, 1869.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The minutes of the previous meeting having been read and confirmed, the following certificates were read:—

For the first time:—Pedlar, Royal College of Chemistry.

For the second time:—James Bell, Howell Hill, Ewell; G. R. Hislop, Gas Works, Paisley; William Ladd, Beak Street, Regent Street; Alfred Bird, Worcester Street, Birmingham; H. Seward, 15 Barnsbury Park, N.; Edwin Lepper, 11 Maiden Lane, Queen Street, Cheapside, E.C.

For the third time:—Samuel Jefferson, Secretary to the Yorkshire Board of Education, Woodville Terrace, Woodhouse Lane, Leeds; Clements Higgins, Demonstrator of Chemistry, King's College, London; James John Bourey, Analytical Chemist, 10 Stepney Causeway, E.

The last-named gentlemen were balloted for and duly elected.

Mr. McLeod gave a verbal account of some experiments he had made on the presence of gases in sea water. At the last meeting he had stated from memory that Thames water contained 6 volumes of gas in 100 of water: on referring to his note-book he found that 100 vols. of this water contained—Nitrogen, 1·398; oxygen, 0·619; carbonic anhydride, 4·180; giving a total of 6·197 vols. in 100 vols. of water. He had experimented upon some sea water collected at Worthing, some distance from the outfall of any river, and which had been exposed to the air for twenty-one months, and found that the amount of gas in 100 vols. was—Nitrogen, 1·104; oxygen, 0·572; carbonic anhydride, 2·620; the total being 4·296. This was very much in excess of the quantity found by Mr. Hunter, as recorded in his paper read at the last meeting, but the quantity of carbonic anhydride was much smaller than might have been expected. The hardness of sea water was greater than that of Thames water, and therefore one would expect a larger quantity of anhydride to have been produced by the distillation. He intended, if possible, to collect some water from the surface of the sea, and to ascertain what quantity of gas it contained.

The President, in thanking Mr. McLeod for his communication, said Dr. Hugo Müller had, he thought, made experiments on the condition of carbonic gas when dissolved in water which led to remarkable results.

Dr. Hugo Müller, in experimenting on the manufacture of soda-water in an apparatus which was formerly much used, found that if the carbonic acid remained in contact with the water for twenty or twenty-four hours, it disengaged itself gradually, adhered to the sides of the glass, and appeared altogether different than when it was left only a short time in contact with the water. He had also noticed that, with the addition of a little common salt, the carbonic acid dissolved much quicker, the chloride of sodium being actually decomposed by the carbonic acid, hydrochloric acid and bicarbonate of soda being formed. He had proved the presence of hydrochloric acid, by ultramarine, which was neither acted upon by carbonic acid nor chloride of sodium. Another instance, in which the chloride was decomposed by carbonic acid, was when carbonic acid was passed through a neutral solution of chloride of lead. In a short time a clear solution was obtained, and, after a certain time, a precipitate consisting of chloro-carbonate was formed.

Dr. Divers observed that, if rectified spirit were mixed with distilled water which contained air through exposure, a kind of effervescence occurred, which he supposed was due to the formation of minute bubbles of air being liberated and rising to the surface. This seemed to show that a mixture of spirit and water had less solubility for air than pure water itself.

The President wondered if the temperature had anything to do with the peculiar state in which Dr. Hugo Müller found the carbonic acid. He had been looking over Dr. Andrews's experiments on the states of carbonic acid at different temperatures, and it would seem that a few degrees of temperature made a great deal of difference in the proportion of the acid, which was not overcome by enormously multiplying the pressure. The observations on the greater solubility of carbonic acid in water containing sodic chloride he thought of great theoretical value, confirmed as they were by the ultramarine test. He (the President) had held, for years, that salts generally dissolved in water by decomposition, and he was interested to find his view confirmed by the introduction of the ultramarine test for the presence of free hydrochloric acid.

After some further remarks from Dr. Hugo Müller, on the chloro-carbonate of lead reaction,

The President alluded to a reaction he had published twenty-four or twenty-five years ago—viz., the action of chlorine in water in the presence of salts like sodic sulphate.

The meeting was then adjourned to January 20th, 1870.

ROYAL INSTITUTION OF GREAT BRITAIN.

General Monthly Meeting, Monday, December 6, 1869.

George Busk, Esq., F.R.S., *in the Chair.*

George Henderson Gibb, Esq., William Harbottle, Esq., John Henderson, Esq.; and Henry Musgrave Musgrave, Esq., were elected Members of the Royal Institution.

The following lecture arrangements for the ensuing season were announced:—

Professor Tyndall, LL.D., F.R.S.—Six lectures (adapted to a juvenile auditory), "On Light." On December 28th, 30th, 1869; January 1st, 4th, 6th, 8th, 1870.

Before Easter, 1870.

Professor Humphry, M.D., F.R.S.—Six lectures, "On the Architecture of the Human Body." On Tuesdays, January 18th to February 22nd.

Professor Odling, F.R.S.—Twelve lectures, "On the Chemistry of Vegetable Products." On Thursdays, January 20th to April 7th.

Robert Scott, Esq., M.A., Director of the Meteorological Office.—Four lectures, "On Meteorology." On Saturdays, January 22nd to February 12th.

Dr. Masters, F.L.S.—Two lectures, "On Plant Life as Contrasted with that of Animals." On Tuesdays, March 1st and 8th.

Professor Rolleston, M.D., F.R.S.—Four lectures; "Deductions from the Comparative Anatomy of the Nervous System." On Tuesdays, March 15th to April 5th.

Professor Max Müller, M.A., LL.D.—Four lectures, "An Introduction to the Science of Religion." On Saturdays, February 19th to March 12th.

Joseph Norman Lockyer, Esq., F.R.S.—Four lectures, "On the Sun." On Saturdays, March 19th to April 9th.

After Easter.

Professor Blackie.—Four lectures, "On the Principles of Moral and Political Philosophy." On Tuesdays, April 26th to May 17th.

Professor Tyndall, LL.D., F.R.S.—Seven lectures, "On Physics." On Thursdays, April 28th to June 9th.

Professor Robert Grant, LL.D., F.R.S.—Seven lectures, "On Astronomy." On Saturdays, April 30th to June 11th.

Professor Seeley.—Three Lectures, "On History." On Tuesdays, May 24th, 31st, and June 7th.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

November 8, 1869.

Joseph Baxendell, F.R.A.S., *Vice-President of the Section, in the Chair.*

The following note was read from Mr. Joseph Sidebotham:—

About fifteen years ago, I had a large cabinet, made of forty-five drawers, to contain shells and carpological specimens, the drawers being made of pencil-cedar. Very soon I found that the resinous vapour from the wood became deposited on some of the fruits and shells, making them appear as if they had been dipped in varnish. Chloroform appeared to be the only solvent, and the specimens were obliged to be washed with it. This became so bad that I had the whole of the drawers removed, and replaced with drawers of bay-wood. Some time afterwards, Mr. Carter advised me to have the cedar drawers sized and papered inside, and a new cabinet made to contain them. Accordingly, he made me one to contain thirty drawers. These drawers were exposed to the air for twelve months, and very well sized inside, and papered; but the resinous vapour is still deposited on the objects in the drawers as before, and, so far, is a warning to every one never to use pencil-cedar for such a purpose. I should not, however, have thought this matter worthy of mention before the Section, had it not been for the very curious and capricious way in which some objects are coated with this resin, while others are left entirely free, and for which I am totally unable to account. In shells, the genera *Conus* and *Oliva* are never touched by it, nor are *Cyprea* or *Mitra*, whilst *Helix*, *Bulimus*, and *Pecten* are coated over. This is the case when there are specimens of these and other genera in the same drawer. As this deposit is on the genera I have named, and never on the others, it would seem to indicate that the texture of some shells would attract the vapour, and not others; but, in the case of birds' eggs, the very strange manner in which some species are picked out, as it were, and others left, is most remarkable. In the owl's eggs, for instance, the barn owl is always free, while the tawny owl is covered with the varnish although side by side. The song thrush is never attacked, and the missel thrush always.

Trays exhibiting these peculiarities were passed round for inspection.

Ordinary Meeting, December 14, 1869.

J. P. Joule, LL.D., F.R.S., &c., President in the Chair.

Sir Charles Lyell, Bart., LL.D., D.C.L., F.R.S., &c., and Henry Clifton Sorby, F.R.S., F.G.S., were elected Honorary Members of the Society. Mr. Robert Routledge was elected an Ordinary Member.

Mr. William Boyd Dawkins, F.R.S., exhibited some old mining tools, brought over by Mr. Bauerman from the turquoise mines of the promontory of Sinai, consisting of a stone-hammer and rude splinters of flint. The turquoises occur in a bed of a quartzose mottled sandstone, in Wady Sidreh and Wady Maghara, in joints running, for the most part, north and south. They were worked, according to the evidence of the hieroglyphic inscriptions on the rock, by the Egyptians from the third to the thirteenth of the dynasties mentioned by Manetho. In and around the workings there are still the tools with which they were carried on. Innumerable splinters of flint, with their points blunted and rounded by use; stone-hammers, some of which are broken; and rounded pebbles, with a concavity on either side, caused by the friction of the thumb and finger, charged with particles of sand; and segments of small wooden cylinders, lie together. The flint flakes exactly coincide with the grooves in the rock made in the excavation, and evidently have been blunted by such use. The fragments of wooden cylinders are believed by Mr. Bauerman to have been portions of the sockets into which the flakes were fitted. The round pebbles were probably used for driving the rude chisel formed by the flint inserted into the wooden socket; while the large stone-hammers were used for breaking up the rock. There was no evidence that metal of any kind was used in the work. Mr. Bauerman also satisfied himself that the hieroglyphs were cut with implements similar to those used in the mining. This discovery is very important, because it opens up the question as to what tools the Egyptians used in working their wonderful monuments of granite and syenite. If it were worth their while to conduct turquoise mining with flint flakes in the Sinaitic promontory, and if they used the same tools in the hieroglyphs that fix the date of these mines (and of this there can be no reasonable doubt), it is very probable that they employed the same means for the same end elsewhere; and that, to say the least, a part of their marvellously minute sculpture in Egypt has also been wrought with flint. There is no evidence that they were acquainted with the use of steel. Iron and bronze are not hard enough for the purpose. The minute and delicate sculpture left behind by the Mexicans, which can be proved to have been worked with stone tools, adds to the probability of this view.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

The ordinary meeting of the Section was held on the evening of Monday, December 6th, Mr. William R. Hutton, Treasurer, presiding. Several candidates were proposed for admission, and several others were balloted for.

The first paper read was entitled, "*Note on the Action of House Sewage on Lead Pipes.*" In introducing it, the author,

Mr. Edward C. C. Stanford, F.C.S., referred to the panic which had recently been shown by the voluminous correspondence in the local papers regarding the alleged impurity of the water used for domestic purposes, and stated that it had revived the old question of the action of the purer kinds of potable water on the lead of the pipes and cisterns. The panic, known locally under the name of "death in the cistern," had been completely allayed by the remarkable unanimity of the reports prepared by Dr. Anderson, Professor of Chemistry, and Dr. Wallace, Analytical Chemist, and backed by an eminent medical authority like Dr. W. T. Gairdner. Notwithstanding, however, that the amount of lead was small, a sufficient quantity had been found in almost all the

analyses of the cistern water to show the desirability of avoiding all suspicion of lead contamination, by adopting a constant high-pressure service in iron pipes, and, where they are required, of using cisterns of iron or slate. The author remarked that much attention had, from time to time, been directed to the action of the purer kinds of potable water upon lead; but it was somewhat remarkable that an equally-important and much wider-spread evil of a similar character had escaped notice. He referred to the serious deterioration which lead pipes undergo which are connected with water-closets; and he brought this subject under the notice of the Section in order that some light might be thrown upon the cause of the said deterioration. Dr. Fergus, a Glasgow medical gentleman, had the credit of first directing attention to the subject by tracing a close connection between the deterioration of the soil-pipes and the existence of various forms of low febrile disease in the houses into which, from the degenerated condition of the pipes, sewer gases make their escape. By means of sketches and used-up specimens of soil-pipes, the author showed the nature of the action to which the pipes are subject from long use—the length of time varying from ten to sixteen years. Near the bend of the pipe leading from the closet the upper part becomes coated with a greyish white deposit that can be easily scraped off, and the interior of the pipe becomes pitted; while, exteriorly, the pipe is at first blistered at the parts corresponding to the internal "pits," and in course of time it becomes quite riddled with holes, and quite gnawed away as it were. Mr. Stanford had analysed samples of the deposit from several soil pipes, and had found from 86 to about 93 per cent of the deposit to consist of plumbic carbonate, the other ingredients being calcic carbonate, silica, insoluble plumbic oxide, water, and organic matter. After noticing the chemical compounds which, in solution in water, act readily upon lead, the author said that the deterioration referred to was not due to those substances, inasmuch as they were found in the excreta, whereas the injury to the pipes took place in the air-space of the bend, and not in the water-space in which the "trapping" was effected. It has been remarked by plumbers, that a piece of lime, or newly-mixed mortar, in contact with a pipe, rapidly eats through it, probably by the lime combining with the carbonic acid of the outside film, and so cleaning the lead that the action of the air repeats the process. In the opinion of the author, alkalies would probably have the same effect as lime, and so clean the lead that a moist atmosphere would act on it. The effect of pure water on lead is first to dissolve it as oxide, and then this is precipitated as oxycarbonate, which is very insoluble, pure water only dissolving 1-60th of a grain per gallon. Water free from air does not act on lead; and the author therefore thought the action referred to might be due to the air carried down by the rush of water while the closet was acting, and by the carbonic acid, or by the ammonia of the gases of decomposition acting as a cleaner, the interior of the pipe being always in a moist condition. Mr. Stanford concluded by recommending the discontinuance of lead soil pipes, and the substitution of earthenware syphons and flanged cast-iron pipes.

Dr. Fergus, in opening the discussion, recommended that soil pipes should be ventilated, or that they should be used as the rain-water pipes. He gave some instances, in his professional experience, of the connection between such diseases as gastric fever, diphtheria, &c, and bad soil pipes; and he strongly urged the periodical investigation of such pipes.

Mr. Sutherland suggested that the action might be due to sulphuretted hydrogen or acetic acid; but Mr. Stanford said that plumbic sulphide had never been found in his analyses.

Mr. Anderson believed that nitric acid, resulting from the oxidation of ammonia, might have some influence in producing the injurious effects on the pipes. This view was supported by Mr. Hutton and Mr. Tatlock. The first-mentioned gentleman referred to experience extending over sixteen years, and said that Loch Katrine water is very peculiar, in having an abundance of dissolved oxygen and very little carbonic acid, and that such water rapidly acts on lead, producing oxycarbonate, which is readily soluble in fresh water from the same source.

Mr. Stanford replied that he had never met with nitrates in the course of his experiments.

A vote of thanks was awarded to Mr. Stanford.

A paper was then read by Mr. R. T. Tatlock, F.C.S., "*On the Estimation of Iodine and Bromine, with special reference to the Analysis of Kelp.*" We are compelled to hold-over this paper for a week.

The ordinary meeting of this section was held on the evening of Tuesday last, Dr. Wallace, F.R.S.E., one of the Vice-Presidents, in the chair. Several new Associates were balloted for and admitted. Thereafter,

Mr. W. R. Hutton, manufacturing chemist, read a paper "*On the Chemistry of Coal-Smoke.*" The author glanced at the subject both in its sanitary and its economical aspects; and then, in order that the scientific principles involved in the prevention of smoke, and in the complete utilisation of the heating power of raw coal, might be properly understood, he gave an analysis of best Wishaw coal, one of the finest kinds of fuel in Scotland. It was as follows:—

Water	2·8
Sulphur	0·4
Volatile matter	36·9
Fixed carbon	56·3
Ash	3·6
	100·0

Volatile Matter.

Carbon	14·0
Hydrogen	6·0
Oxygen	15·9
Nitrogen	1·0
	36·9

In the ordinary combustion of coal, black smoke, and therefore soot, is only producible from the volatile matter of the coal, the fixed carbon, ash, &c., being incapable of generating smoke. The value of a fuel as a generator of heat is estimated according to the amount of carbon and hydrogen present in it. As ordinarily used, coal, during its combustion, gives rise to many curious compounds, including carbonic oxide, carbonic acid, watery vapour, ammonia, sulphurous and sulphuric acids, and various hydrocarbons, some of the paraffin series, and others of the naphthalin series; and, as they are volatile when liberated, they rise into the atmosphere and form the mixture known as coal-smoke. This material differs in its properties and composition, according to the composition and mode of burning the coal; but, in all cases, sooty carbon and moisture are abundant, the former especially so in black smoke. But black smoke is soot, and is the result of the imperfect combustion of the coal, and even of its wasteful use. Mr. Hutton then went on to examine soot in its chemical aspects, and explained, in detail, how the difference of temperature in a furnace or domestic fire regulates the composition of the volatile matters of soot. The composition of London and Glasgow soot was shown in a table, of which the following is a copy.

Analysis of Soot.

	London.	Glasgow.
Carbon	53·18	35·7
Tar and oil	18·00	15·0
Ammonia	1·75	2·8
Potash	0·20	0·3
Soda	0·34	0·3
Lime	1·00	0·8
Magnesia	0·30	trace

	London.	Glasgow.
Phosphate of lime and alumina.	2·08	3·2
Iron	0·40	0·7
Sulphuric acid	4·60	7·9
Chlorine	trace	0·4
Sulphocyanogen	0·25	none
Carbonic acid	0.70	trace
Sand	14·40	25·7
Water	2·80	7·2
	100·00	100·0

The author said he could guarantee the genuineness of the sample of London soot; but he was afraid that the Glasgow soot which he had examined was adulterated, judging by the large percentage of sand and water contained in it. The large proportion of sulphuric acid might be accounted for by the sulphurous quality of the Scotch coal, and by the great number of chemical works in Glasgow. Genuine Glasgow soot ought to contain a larger amount of ammonia: both samples were distinctly acid. While referring to the various uses of soot, Mr. Hutton mentioned that a considerable quantity was recently shipped to the West Indies, to be used there for the growth of the sugar-cane. The price is from 30s. to 40s. per ton. Considering that soot rarely contains less than about one-sixth of its weight of hydrocarbon compounds, the author of the paper proceeded to look at the production of soot from a commercial point of view, and asked if the value of soot is proportionate to the evils resulting from the production of the material. Not more than 500 tons are gathered in Glasgow per annum, and the value never exceeds £1000. Taking the waste of fuel, the loss of the nitrogen of the coal, the destruction of property, and the personal discomfort resulting from smoke and soot, he found that there was no profit, but rather a great loss instead. As a practical solution of the "smoke nuisance," Mr. Hutton briefly sketched a plan by which practically smokeless fires might be obtained, while all the volatile compounds could be separately collected, and be got in a form fit for utilisation. He would distil the coal before burning, stopping short the process of distillation at such a stage as would permit *soft coke* to be formed—that is, fixed carbon with a sufficient amount of volatile matter in it to render it slightly inflammable. The other useful products would be chiefly crude oil, coal-gas, and ammonia. Assuming, as a basis of calculation, 2000 tons of coal to be used daily, that amount would yield, in round numbers—

Soft coke	1400	tons.
Crude oil	40,000	gallons.
Ammoniacal water	30,000	"
Coal gas	6,000,000	cubic feet.

Deducting the ash, the fixed carbon would be reduced to 1329 tons. Mr. Hutton calculated that the coke and the other products would realise £742, while the coal (at 5s. per ton) and the labour, &c., would cost £600, leaving an apparent balance of £142, in addition to all the other advantages which would result from the complete combustion of the fuel. The coke would be such a material as would be available alike for domestic fire-places and the furnaces of steam-boilers, &c.

At the conclusion of the paper, various members spoke in commendation of Mr. Hutton's views. In reply to Mr. Stanford,

Mr. Hutton stated that such coke as he had suggested in his paper could be burned in the ordinary grate, without the expense or any other of the inconveniences attending the use of the grate which was devised some years ago by the late Dr. Neil Arnott.

On the motion of the Chairman, a cordial vote of thanks was awarded to Mr. Hutton; and the meetings of the Section were adjourned for a month.

ROYAL IRISH ACADEMY.

The general meeting of this society was held on Tuesday, November 30th, Right Hon. the Earl of Dunraven in the chair.

The first business was the election of a president, in room of Lord Talbot de Malahide.

Dr. Loyd, Provost of Trinity College, moved that the Rev. John Jellett, F.T.C.D., be elected president. He said that Professor Jellett's high scientific claims were thoroughly known by the members of the Academy, before which body his investigations had been brought. In the higher abstract sciences, Professor Jellett was second to none in this part of the empire, with the exception of one, who had retired, and he combined scientific attainments which were not often found in the same man. Dr. Stokes, in the absence of Dr. Russell, President of Maynooth, seconded the motion. Professor Jellett was duly elected by ballot. This election gives general satisfaction, as it has been felt for some time past that the scientific element in the Academy "has not," as the Earl of Dunraven expressed it, "taken the position that was its right."

Sir William Wilde then read a paper upon "*A Collection of Gold, Bronze, and Iron Antiquities Found in Excavations made for the Supplying of Gravel to the City.*" They were supposed to be of Scandinavian origin.

Dr. Apjohn then read a paper "*On the Proximate Analysis of Saccharine Substances.*" In this method, the author makes use of the optical and chemical processes, and thus quantitatively determines the amount of cane sugar, inverted sugar, and grape sugar in a given sample. An extended report of this paper will shortly be given in the Chemical News.

NOTICES OF BOOKS.

The Students' Chemistry; being the Seventh Edition of Household Chemistry, or the Science of Home Life. By Albert J. Bernays, Ph.D., F.C.S., Professor of Chemistry and of Practical Chemistry at St. Thomas's Hospital Medical and Surgical College, &c., &c. 1869. W. H. Allen and Co.

The well-known and popular work of Dr. Bernays has, in this new edition, been so completely altered and recast that it is, in point of fact, a new book. The experiment of altering the form of a work which has met with such marked favour from the public is a bold one, but we have no hesitation in predicting that, in the present instance, it will be entirely successful.

The book, in its present form, has no longer the popular and readable character that it formerly possessed; but, on the other hand, it is now what it never was before, a systematic and complete manual for students. It is very lucid in style and practical in matter. It contains a vast mass of fact simply and accurately stated, and bound together by just as much theory as is necessary for the understanding and remembering of it. The notes with which each chapter is headed are very clear and full, and will assist the labours of the student most materially. The author promises to devote a second volume to organic chemistry and to the theories of the science, and confines the present one to inorganic chemistry.

If this second volume is as good as the first, it will be a very useful book.

The Life and Letters of Faraday. By Dr. Bence Jones, Secretary of the Royal Institution. London: Longmans, Green, and Co. 1870. 2 vols. 8vo, with illustrations.

I.

We all remember the terse and pregnant account of the life of Faraday which appeared last year in the *Proceedings*

of the Royal Society, and which was written by Dr. Bence Jones. Here we had the broad outlines and main incidents of Faraday's great career; in the work before us we have the details of the picture, the delicate tintings, and careful finish—we have the details of Faraday's life, together with the more prominent incidents which were before known to us. The present "Life" is almost an autobiography; Faraday's letters are frequently quoted *in extenso*, and his manuscripts and journals have been freely consulted. Dr. Bence Jones had at one time hoped that the journals which Faraday wrote when abroad would have been published separately, when, as he remarks, "some portions of his biography would have been in his own handwriting; but it was thought undesirable to divide the records of the different parts of his life."

The principal facts connected with the life of Faraday have been previously enumerated in this journal and elsewhere; we shall assume, therefore, that it is unnecessary to bring before our readers any specially-connected biography, but shall rather content ourselves with noticing here and there some of the less-known phases of a life which we all admire so profoundly, and all so desire to emulate. The desultory character of this notice, therefore, arises from the belief that we have already in our minds, to a greater or lesser extent, a biography of the greatest natural philosopher of our epoch.

In reading Faraday's first letters to Mr. Abbott, which were written when he was twenty years old (1812), we cannot fail to be impressed, not by the amount of knowledge which he had acquired, so much as by the amount of thought which he had exercised. He had already read largely, and had not confined himself by any means to scientific works, but was evidently well acquainted with many of the classics of English literature. These letters are long, somewhat verbose, and decidedly more turgid in style than his later letters; in fact, we notice as we proceed a gradual assumption of that charming simplicity and clearness in writing which all his later compositions possess. An inflated style is the common error of young writers, and it is more often noticed at one certain period of a career, when the writer has rapidly and almost abnormally, so to speak, acquired learning and a taste for expressing his own ideas, than when it has been more gradually amassed, or to a less degree. Faraday had an early opportunity of lecturing, for he joined the City Philosophical Society in 1813, and it was the duty of each member, in rotation, to deliver a lecture. At this time, also, he was in the habit of meeting a few of his more intimate friends for purposes of mutual improvement; they "met of an evening to read together, and to criticise, correct, and improve each other's pronunciation and construction of language."

Shortly after his engagement at the Royal Institution, Faraday wrote several letters to his friend Abbott, on the subject of lecturing, and the qualifications which a lecturer ought to possess (pp. 70-79); these are well worthy the perusal of all who may be engaged in lecturing or science teaching; we find in them many of the precepts which Faraday followed through life, the observance of which made him the most lucid and elegant lecturer of our day. "A lecturer," he writes, "should endeavour, by all means, to obtain a facility of utterance, and the power of clothing his thoughts and ideas in language smooth and harmonious, and at the same time simple and easy. His periods should be round, not too long or unequal; they should be complete and expressive, conveying clearly the whole of the ideas intended to be conveyed. If they are long, or obscure, or incomplete, they give rise to a degree of labour in the minds of the hearers which quickly causes lassitude, indifference, and even disgust." . . . "A lecturer falls deeply beneath the dignity of his character when he descends so low as to angle for claps, and asks for commendation. Yet have I seen a lecturer even at this point. I have heard him causelessly condemn his own powers; I have heard him dwell for a length of time on the extreme care and niceness that the experiment he will make requires; I have heard him hope for indulgence when no indulgence was wanted; and I have even heard him declare that the experiment now made cannot fail, from its beauty, its correctness, and its application to gain the approbation of all."

During his travels on the Continent with Sir H. Davy, Faraday appears to have kept a careful journal; and this eighteen months of his life, although at times very distasteful, must have had a great effect on the formation of his mind and character, or rather in hastening or ripening his more prominent characteristics. It was, of course, a matter of much benefit to him (too often forgotten by those who speak of his self-education, without any of those advantages which the educated usually possess, &c.) to be in constant communication with one of the most brilliant and profound chemists in Europe, to work with him and for him, to notice the tone and manner of his thought, his treatment of questions of science, his mode of interrogating nature. It was advantageous to see other countries, study other languages, to examine scientifically, and with such a man as Davy, various natural phenomena and results of former phenomena not presented to us in these Islands. We find him one day working at the compounds of iodine (then recently discovered) in the laboratory of the Jardin des Plantes; on another, making the ascent of Vesuvius; he is now burning diamonds with Cosmo de Medici's great lens, now at a masked ball in a domino, or a spectator of the races in the Corso. During his tour, he appears to have had a good deal of time to himself, although, in certain respects, he did not find his post of amanuensis either a sinecure, or exactly what he expected as regards occupation.

Faraday returned to England in 1815, and now commenced his "early scientific training at the Royal Institution." He gave seven lectures during the year at the City Philosophical Society, on various subjects connected with chemistry, and he published his first paper ("An Analysis of Native Caustic Lime") in the *Quarterly Journal of Science*. In concluding his fifth lecture, he says:—"The philosopher should be a man willing to listen to every suggestion, but determined to judge for himself. He should not be biassed by appearances, have no favourite hypothesis, be of no school, and, in doctrine, have no master. He should not be a respecter of persons, but of things. Truth should be his primary object. If to these qualities be added industry, he may, indeed, hope to walk within the veil of the temple of Nature."

Five years later, Faraday, who was then in his twenty-ninth year, commenced what Dr. Bence Jones has well called his "higher scientific education at the Royal Institution." He had for seven years been the private assistant of Davy, and assistant in the laboratory and lecture-room. He had lectured with much success, both in the matter of speech and of experiment, and he had published thirty-seven notices and papers in the *Quarterly Journal of Science*. Yet, with all this, he did not publish the first of his "Experimental Researches on Electricity" for eleven years from this date; and this period between the end of his first seven years of science-study and the commencement of the publication of these great researches was the time of his higher education in science. Faraday had for many years kept a common-place book. In 1822, he commenced a new and more detailed note-book, which he called "Chemical Notes, Hints, Suggestions, and Objects of Pursuit." In this, we find mention of many researches, which were elaborated and published at a later date. For instance:—

"General effects of compression, either in condensing gases or producing solutions, or even giving combinations at low temperatures.

"State of electricity in the interior and on the surface of conductors, and on the surface of holes through them.

"Transparency of metals. Sun's light through gold-leaf. Two gold leaves made poles—light passed through one to the other."

At a later date, he wrote at the commencement of this collection of notes– "I already owe much to these notes, and

think such a collection worth the making by every scientific man. I am sure none would think the trouble lost after a year's experience."

In 1823, Faraday was elected a Fellow of the Royal Society; and other scientific honours now began to be offered him. He received, altogether, ninety-five honorary titles; and of these he said:—"One title—namely, that of F.R.S.—was sought and paid for; all the rest were spontaneous offerings of kindness and good-will from the bodies named."

In 1825, on the recommendation of Sir H. Davy, Faraday was appointed Director of the Laboratory of the Royal Institution; and one of his first acts was to invite members of the Institution to attend evening meetings in the Laboratory, at which Faraday showed new and striking experiments. From these meetings sprang the Friday evening discourses so well known to all of us, and the establishment of which probably, remarks Dr. Bence Jones, "saved the Institution."

Let us, now that we have arrived at the last year (1839) of Faraday's higher scientific education, pass in review some of his work, before passing to the commencement of that great series of researches which numbered more than fifteen thousand paragraphs, and was concluded in 1856.

He had already made notable researches on electro-magnetic motions, on the condensation of gases, on the manufacture of glass for optic purposes, and on the alloys of steel. He had discovered two chlorides of carbon, benzol and sulpho-naphthalic acid; and he had made various experiments on the diffusion of gases. Moreover, he had published sixty scientific papers, nine of which were in the *Philosophical Transactions*. Here, then, for the present, we will leave him, in his thirty-ninth year.

II.

The second volume of this work is divided into four chapters, of which the first treats of Faraday's "First Period of Electrical Research," included between the years 1831 and 1840, and extending to his forty-ninth year. The great discoveries of this period of his life were those of magneto-electricity and of definite electrical decomposition. So early as 1831, we find the germ of the idea of "lines of force"—an idea which pervaded all his succeeding philosophy. "By magnetic curves," he writes, "I mean lines of magnetic forces which would be depicted by iron filings." The first series of his "Experimental Researches in Electricity" was the result of ten days' labour, and was read on November 24th, 1831, at the Royal Society. The full course of these researches, together with the dates, has been so carefully noted by Dr. Bence Jones, in the notice of Faraday which appeared in the *Proceedings of the Royal Society* for last year, that it will be needless to enter into any detail here; moreover, the main facts of these great researches are more or less known to all of us, and require but little description. We may mention that the appendix to Chapter 1 contains an example of the notes from which Faraday lectured. On one side of a sheet of paper, he was in the habit of setting down the experiments, numbered and in order, and accompanied by divisions of the lecture-hour into intervals of minutes, varying from five to fifteen; on the other side, the notes of subject-matter were written, with figures corresponding to the numbered experiments.

The second chapter includes the years intervening between 1841 and 1844, and is entitled "Rest between the Periods of his Experimental Researches—Swiss Journal—Nature of Matter." The intense mental labour connected with the electrical researches had brought on attacks of giddiness and loss of memory, and for four years Faraday undertook but one research connected with electricity. He entirely rested during one year, even giving up lecturing at the Royal Institution; and he spent three months of this time in Switzerland. The journal which he kept during this period is full of interest, and shows us the character of the man apart from his science; and it may be here remarked that, although we are apt to study this character more in reference to Faraday's great efforts of scientific thought, it is equally worthy of minute study for other reasons, for the humanity, the gentleness, the love of truth, and the consistency, which were such prominent characteristics of the man.

In 1843, the present Emperor of the French, at that time a prisoner in the Fortress of Ham, addressed several letters to Faraday on scientific subjects. We here find the Emperor appearing in an altogether novel light—viz., as the propounder of a new theory of the action of the voltaic pile, which was read to the Academy by M. Arago, but which does not appear to have been received with much warmth. The Emperor, however, shows that he possessed some knowledge of electricity, and his remarks and inferences are by no means superficial. In some of his experiments he required a galvanometer, but could not succeed in constructing one "parceque les aiguilles aimantées furent toujours déviées par l'attraction des barreaux de fer qui entourent mes fenêtres." Sometimes he seems to have thought of applications of voltaic electricity to purposes of war:—"*What is the most simple* combination," he asks Faraday, "to give to a voltaic battery, in order to produce a spark capable of setting fire to powder under water or under ground?"

The third chapter comprises the period between 1844 and 1855, and extends to Faraday's sixty-fourth year: it discusses "Later Period of Electrical Research—Discovery of the Magnetisation of Light—The Magnetic State of all Matter—Atmospheric Magnetism." The discoveries made during this second period of electrical research were published in the eleven series of "Experimental Researches in Electricity" included between the nineteenth and the thirtieth. Although the discovery of the magnetisation of light (which Sir William Thompson has designated "the greatest discovery of this century"), was among these discoveries, Dr. Bence Jones considers that, "great as these discoveries were, they will not at the present time rank with the three great discoveries of magneto-electricity, voltaic induction, and definite electro-chemical decomposition, which made the glory of the earlier period of the 'Researches in Electricity.'"

Here are some remarks drawn at random from various lectures given at the Royal Institution during the year 1845. Speaking of the fineness of gold wire, he said—"Four sovereigns' weight of pure gold could be drawn into a wire long enough to surround the globe." In a lecture on mercury, he said—"Lecture-room, with all its walls, floors, roofs, &c., from top to bottom, and full of people, if standing in a trough of mercury having the same base as the lecture-room, would only raise a column at the sides 17½ inches high." Of the voltaic battery, he said—"This instrument has done—is doing—more in developing the internal molecular powers of bodies, and the unity of the various forces in nature, than any other offspring of human thought." Speaking of evening lectures at the Royal Institution, he said—"As to popular lectures (which at the same time are to be *respectable* and *sound*), none are more difficult to find. Lectures which *really teach* will never be popular; lectures which are popular will never *really teach*. They know little of the matter who think science is more easily to be taught or learned than A B C; and yet who ever learned his A B C without pain and trouble?" In a letter published in the *Philosophical Magazine* for 1846, in which we find some of Faraday's boldest and grandest speculations, we have one of the many examples of the singular modesty and humility with which, even at the summit of his fame, he propounds a theory. "I think it likely," he says in concluding, "that I have made many mistakes in the preceding pages, for even to myself my ideas on this point appear only as the shadow of a speculation, or as one of those impressions upon the mind which are allowable for a time as guides to thought and research. He who labours in experimental inquiries knows how numerous these are, and how often their apparent fitness and beauty vanish before the progress and development of real natural truth."

In 1855, Faraday concluded his "Experimental Researches in Electricity." They had extended over a period

of twenty-six years, and undoubtedly constitute his greatest and noblest work; the ultimate issue and result of the work it is impossible to estimate, each branch of it as left by him, nay, the smallest twig, may be transplanted, until a very forest is the result. It has stimulated, and will stimulate work; it admits of an infinity of applications; above all, it is a grand example of accurate work, combined with accurate thought, with method, with genius, with a refined manipulation, and a subtle mind. Let us glance at the main results of his electrical researches, in the order in which they occur. "The Induction of Electric Currents—The Evolution of Electricity from Magnetism—Terrestrial Magneto-Electric Induction—Identity of Electricity from Different Sources—Conducting-Power generally—Electro-Chemical Decomposition—Electricity of the Voltaic Pile—Induction of a Current on Itself—Static Induction—Nature of the Electric Force—Character of the Electric Force in the Gymnotus—Source of Power in the Voltaic Pile—The Electricity evolved by the Friction of Steam—The Magnetisation of Light, and the Illumination of Magnetic Lines of Force—New Magnetic Actions—The Magnetic Condition of all Matter—The Crystalline Polarity of Bismuth, and its relation to the Magnetic Form of Force—The possible relation of Gravity to Electricity—The Magnetic and Dia-Magnetic Condition of Bodies, including Oxygen and Nitrogen—Atmospheric Magnetism—Lines of Magnetic Force, and the Employment of Induced Magneto-Electric Currents as their Test and Measure—The Constancy of Differential Magne-Crystallic Force in Different Media—The Action of Heat on Magne-Crystals—The Effect of Heat upon the Absolute Magnetic Force of Bodies."

This magnificent work was done under conditions of penury; yet, "during a great part of these twenty-six years, the Royal Institution was kept alive by the lectures which Faraday gave for it." Faraday received, during the greater part of this time, £100 a-year from the Institution, and nearly £100 as Fullerian Professor. He kept account of his expenditure in research and apparatus literally to the uttermost farthing. Altogether, Faraday laboured for science for fifty-two years, one-half of which time was devoted to the "Experimental Researches in Electricity."

In June, 1862, Faraday gave his last Friday evening discourse at the Royal Institution. The following are the notes which he made for this his retirement from active duties:—

"Personal explanation,—years of happiness here, but time of retirement; Loss of Memory, and *physical* endurance of the brain.

"1. Causes—*hesitation and uncertainty* of the convictions which the speaker has to urge.

"2. *Inability to draw* upon the mind for the treasures of knowledge it has previously received.

"3. *Dimness*, and forgetfulness of one's former *self-standard*, in respect of *right, dignity*, and *self respect*.

"4. Strong duty of *doing justice to others*, yet inability to do so.

"5. *Retire*."

Who among those present will ever forget the intense enthusiasm which was exhibited at the conclusion of the lecture "On Platinum," nearly the last which Faraday gave? "I have desired to retire," he said, "as I think every man ought to do before his faculties become impaired; but I must confess that the affection which I have for this place is such that I hardly know when the proper time has arrived." No victor in the Olympian games, no conqueror ascending in triumph the Capitoline Hill, no *prima donna* in the height of her fame, ever received a more complete ovation.

"For thirty-eight years," says Dr. Bence Jones, "his lectures were the life of the Royal Institution. His singular power of making himself one with his audience was felt in his Juvenile Lectures, in his Theatre Courses, and in his Friday Evening Addresses." His great success as a lecturer may be attributed to his careful attention to strict rules; some of his earlier remarks on lecturing we gave in the first of these notices; the following rules were found among his notes:—

"Never to repeat a phrase.

"Never to go back to amend.

"If at a loss for a word, not to ch—ch—ch, or ch—eh—eh—, but to stop and wait for it. It soon comes, and the bad habits are broken, and fluency soon acquired.

"Never doubt a correction given to me by another."

In addition to this strict attention to rules, Faraday took lessons in lecturing in 1823, and again in 1825 and 1826, before giving his first course of lectures in the Institution.

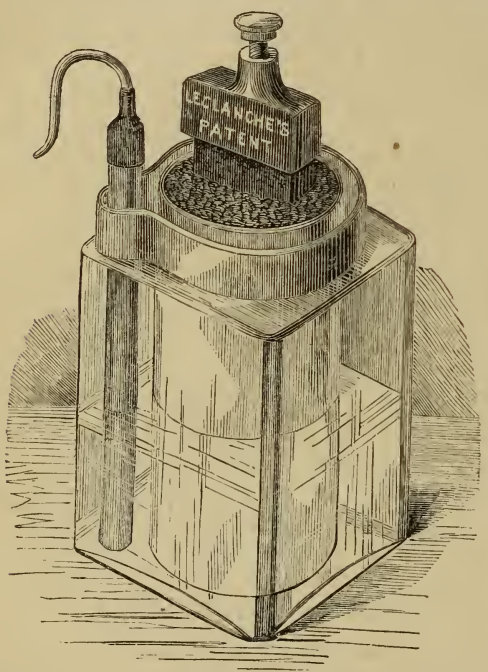
Dr. Bence Jones closes his admirable "Life of Faraday," by a statement of the chief of the characteristics of the great philosopher, and of the qualities which combined to render him so noble and so good. "As a philosopher, his first great characteristic was the trust which he put in facts. . . . His second was his imagination. It rose sometimes to divination, or scientific second-sight, and led him to anticipate results that he or others afterwards proved to be true." As a man, his first and greatest quality was his truthfulness; the second, his kindness; the third, his energy. "His religion was a living root of fresh humility, and, from first to last, it may be seen growing with his fame and reaching its height with his glory, and making him, to the end of his life, certainly the humblest, while he was also the most energetic, the truest, and the kindest of experimental philosophers. . . . His standard of duty was supernatural; it was not founded upon any intuitive ideas of right and wrong; nor was it fashioned upon any outward expediences of time and place; but it was formed entirely on what he held to be the revelation of the will of God in the written Word, and throughout all his life his faith led him to act up to the very letter of it."

Much has been said and written about the Faraday Memorial, and the proposition to erect a monument to him in St. Paul's cathedral is being actively advanced. Looking at his many and great works, and at this last record of him, full of his every-day thoughts and actions, we are tempted to repeat the hackneyed, but here infinitely appropriate, phrase, "*Si monumentum requiris, circumspice.*" Of Faraday himself we may truly say, "Exegit monumentum ære perennius." Yet there should be some mark of the popular esteem for such a man—and if it takes the form of a statue, it should be among the quick, not among the dead. It should be in the busy world and in the light of day, that they who pass by may stay, and read, and remember. Whoever enters St. Paul's, must feel the gloomy chill of the vast, silent edifice; all is dull and gloomy, and the surroundings recall to us obsequies, and friends mourning and the terrors of death. We would not have the statue of Faraday placed here; we would not wish to think of him with sorrow in our hearts and ashes on our heads; but we would have the memorial in our often view, and unencompassed by aught that brings feelings of gloom and unhappiness, in that we shall see him no more. To one who asked him, during his last years, how he was, he replied "Just waiting." Let us think of the old philosopher as he sat by his window at the close of life looking out upon the green trees and fields of Hampton, and delighting in the beauties of that Nature he had loved so fondly. He who had been so strong, so mighty to prevail, was now as a little child. The *lumen purum* of the great intellect which had penetrated the mysteries of Nature as few had ever done before, was flickering, and faint, and dim. *Nunc dimittis*,—"the sweetest canticle of all when a man hath obtained worthy ends and expectations"—is the thought which fills his mind; and as he gazes into the bright world without, the landscape fades almost imperceptibly from his sight, the voice of nature is hushed, and there comes a momentary darkness, the precursor of a perpetual light.

Treatise on the Leclanché Battery: Preceded by a Few Remarks on the Employment of Electrical Batteries in Telegraphy. London: The India Rubber, Gutta-Percha, and

Telegraph Works Co., Silvertown, Essex, and 100, Cannon Street, London.

In this pamphlet will be found a full description of the Leclanché cell, the main feature of which is that peroxide of manganese is used with zinc (amalgamated) and an aqueous solution of an alkaline salt, chloride of ammonium being preferred. The author states, and his statement is borne out by comparative experiments made with the Marié-Davy, Daniell, and Bunsen cells, that the Leclanché cell is preferable to any other. The cells are of three sizes, and the shape is shown in the accompanying cut; the smallest, with a porous pot 4·3 inches high, can accomplish an annual electric work which may be represented by 620 grains of copper reduced in the voltameter; the medium size, with a 6-inch porous pot, can reduce from 950 to 1000 grains, while the large size gives a work equal to 1500 or 2000 grains. We have ourselves



tried the cell, and can recommend its use to those who require galvanic electricity for telegraphic or other purposes.

Stereograms of Mars, with a Chart of Mars on Mercator's Projection, and Descriptive Remarks on the Stereograms. By R. A. Proctor, B.A., F.R.A.S. London: John Browning, 111, Minories.

We learn, from Mr. Proctor's remarks, that these stereograms are photographs from the globe of Mars which Mr. Browning constructed in the spring of 1868, the edges of the pictures being softened by hand. Viewed in the stereoscope, they give a singularly real and solid figure of the planet, and will not only afford the astronomer an opportunity of studying Mr. Browning's globe, but will also enable him to test the accuracy of his own observations. In producing these admirable stereograms, Mr. Browning has rendered another important service to the science of astronomy.

A Pharmacopœia, Including the Outlines of Materia Medica and Therapeutics, for the Use of Practitioners and Students of Veterinary Medicine. By Richard V. Tuson, F.C.S., Professor of Chemistry and Materia Medica at the Royal Veterinary College. London: John Churchill & Sons. 1869. Pp. 311.

The preface informs us that this work is designed for the use of practitioners and students of veterinary medicine. The agents are arranged in alphabetical order, according to the plan adopted in the "British Pharmacopœia," and are treated of under the following heads:—(1) Latin Pharmaceutical Name; (2) English Pharmaceutical Name; (3) Synonyms; (4) Compositions; (5) Mode of Preparation; (6) Characters and Tests; (7) Actions and Uses; (8) Doses; (9) Modes of Application; (10) Incompatibles; (11) Antidotes; (12) Preparations. This work bears evidence of the progress of scientific veterinary medicine in this country, which has hitherto in this respect remained backward as compared with France, Belgium, and Germany, and last, but not least, with the Netherlands, where scientific veterinary medicine has replaced rude and clumsy empiricism and quackery since the middle of last century. Veterinary medicine requires in its practitioners an amount of tact and spirit of patient observation, which in some respects makes it as difficult a practice as that of the diseases of infants and young children. The book of Professor Tuson is carefully written, and is a valuable addition to the literature of the subject. It will be valued not only in this country, but in many parts of Europe, as well as in that great portion of America where the English language is widely used and known. The composition of bodies is expressed in modern atomic weights, a table of which, together with a list of the old ones, is appended. At page 24 we meet with Aër Chlori; it would have been better to write chlorium gasiforme, or gas chlorium. Aër is strictly limited to the atmospheric air we breathe, and if it is desired to express the state of aggregation of chlorine at all, it is best, we think, to use the word *gas*, first introduced by the well-known Van Helmont; instead of *aërial* we should prefer gaseous. We notice with pleasure the excellent tables of weights and measures of the metrical system, and the relation of these weights to the British and *vice versâ*. The index to veterinary medicines, *arranged according to their actions and uses*, has been very carefully compiled, and it is a very useful feature therein that the Greek and Latin words have been properly explained and their derivation made clear. The work is well executed, being printed in a very clear and legible type, and has been carefully revised, since we have not, on perusing it, met with any clerical errors. We recommend the book with pleasure, and hope that veterinary medicine may rise, as it ought, in the estimation of scientific, and especially medical men, who should consider that the veterinary physician may exercise, by the proper attendance to his calling, a great influence for the general public good. Seeing that that portion of *Police Science*, as Dr. H. von Mohl calls it, which is termed "Administration de la Sûreté et Salubrité Publique," is in this country an ill-defined and rudely digested chaotic mass, one cannot wonder that sufficient care has not been taken to assign to veterinary medicine its proper place and the social status it really deserves.

A Treatise on Asiatic Cholera. By C. Macnamara, Surgeon to the Calcutta Ophthalmic Hospital. London: John Churchill & Sons. 1870.

As may be expected from a medical man resident in the endemic area of cholera, this work contains very valuable information on a most difficult subject. From Section II., "On the Historical Account of Cholera," we learn what the Sanskrit writers have recorded on this subject; the translation given of an *historia morbi* by Susruta is highly interesting, and the more so to those who ever have witnessed patients attacked by Asiatic cholera, since they can hardly fail to observe the great resemblance this description bears to the reality; and from the vestige of a remote antiquity it would also appear that the disease has been in existence sporadically long before our era. The earliest notice of the existence of cholera in Hindostan, from the pen of a European, occurs in the "Lendas da India," by Gaspar Correa, in the year 1503; the entire chapter on the history of this disease is in every way interesting, and contains a great deal of

hitherto unknown, or, at least, not well collected information. The section on the geographical distribution of cholera, and that on the bearing of meteorological influences upon the spread of this disease is also very valuable; the etiology of cholera is lucidly treated of, and the theories of Messrs. Bayer Pettenkofer, Farr, and others, discussed in a clear manner. The value of the work is enhanced by the addition of several official reports, well executed maps, and statistical diagrams. As is usual with these publishers, this work is brought out in excellent style, and is a most valuable addition to the bibliography on this subject.

CORRESPONDENCE.

The Atomic Theory.

To the Editor of the Chemical News.

Sir,—Is it not surprising that, during the recent discussion on Professor Williamson's admirable paper on "The Atomic Theory," no one should have hit upon the simple link which unites the opposing doctrines?

Modern chemistry teaches us that the existence of matter as atoms and molecules is pretty nearly as certain as the existence of matter itself. It is only since that conception has been fully adopted, and by means of it, that chemistry has been raised into an exact science; and the idea involves the indivisibility of the ultimate atom.

On the other hand, mathematical science proves that such a thing as an indivisible atom having size and weight is simply an impossibility; and therefore people fear to accept the theory as absolute truth, but are compelled to use it grudgingly as a temporary expedient.

But why? both sides are correct. The atoms are the ultimate forms of matter *as we know it*, in the form of chemical elements; they cannot be divided, and remain those elements. But no one can affirm, or would think of doing so, that these elements are positively the ultimate forms of matter itself. On the other hand, there is a general feeling, justified by the remarkable relations between the atomic weights and properties of elements, that they are very probably compounds of yet simpler forms of matter, though their decomposition may not be possible to man. The doctrine of atomicity, showing us several centres of force in each atom, confirms this.

Hence, although the chemist can only deal with ascertained facts as a chemist, yet he loses none of his rights to the teachings of mathematics, and is quite entitled to believe that matter may be infinitely divisible and non-atomic in its ultimate essence, and yet be atomic and indivisible in the forms in which he has to deal with it.

May not the interplanetary ether be this ultimate form, and the tremendous actions of the sun, with its vast masses of hydrogen, be a stage of resolution of ordinary elements into this form, to be driven into space, and again condensed into ordinary matter, thus keeping up that circulation of existence which seems to be the fundamental system of Nature?—I am, &c.,

John T. Sprague.

Coal Dyes in 1818.

To the Editor of the Chemical News.

Sir,—I read in *Blackwood's Magazine*, for, June, 1818, p. 339, the following paragraph, which may, perhaps, be interesting to many of your readers:—

"*New Extracts from Coal.*—Dr. Jassmeyer, Professor of Chemistry in Vienna, has discovered the means of extracting from coals two hitherto unknown acids, a resin, a resinous gum, and other elements, which he has employed with surprising success to the purposes of dyeing wool, silk, hair, and linen, and has produced from them red, black, yellow, and various shades of brown and grey. Count von Chorinsky, President of the Aulic Chamber, and many other enlightened judges of these matters, were present at these experiments, and testified their entire approbation of this useful discovery."

Can any of our brother chemists inform us whether these products are known at the present day, and under what names?—I am, &c.

T. L. Phipson, Ph.D., F.C.S.,
Member of the Chemical Society of Paris.

Analytical Laboratory, Putney, S.W.
November 29, 1869.

The Meteoric Iron of Deesa.

To the Editor of the Chemical News.

Sir,—I find in the Chemical News (vol. xx., p. 274; *American Reprint, Feb.*, '70, *page* 99), an abstract of the memoir published by *Cosmos* concerning the meteoric iron of Deesa.

Allow me to observe that the results indicated (except those which relate to the elementary composition of the metallic part) have not been obtained by M. Domeyko, but by myself.

I will add that the examination of the Deesa mass has led me to considerations which I believe to be new on the origin of meteorites.

The characters offered by this mass are such that it is impossible not to perceive in it a specimen of the first *meteoric eruptive rock* hitherto observed.

Consequently, the meteorite mass of Deesa permits us to affirm that meteorites, anciently in *statographical relations*, come from a globe, now broken up, which formerly revolved round the earth.

Finally, the consideration of *meteoric dykes* gives us the relative geological age of meteorites.

I shall be very glad if this letter can find a place in your most valuable journal.—I am, &c.,

Stanislas Meunier,
Docteur ès Sciences,
Aide Naturaliste au Museum.

23, Rue de Vaugirard, à Paris, Dec. 4, 1869.

Phosphamides.

To the Editor of the Chemical News.

Sir,—In your last number, among the "Chemical Notices from Foreign Sources," is an abstract of a paper by Schiff, in Beilstein's *Zeitschrift für Chemie*. In that paper he comments on one of mine, and re-asserts the existence of phosphotriamide, $P(NH_2)_3O$; but it is evident that his acquaintance with my communications to the Chemical Society on the various phosphamides is imperfect, and a statement of the different results of our experimenting may not be without its value.

Schiff's statement is that ammonia gas, passed over oxychloride of phosphorus, is capable of eliminating the whole of the chlorine, producing a triamide, thus:—

$$PCl_3O + 6NH_3 = P(NH_2)_3O + 3NH_4Cl;$$

and that this triamide may be separated from the chloride of ammonium by means of water, in which it is insoluble.

My statement is that I have never succeeded in replacing more than two equivalents of chlorine at any temperature, and that the amidated oxychloride thus produced is at once decomposed by water with the formation of pyrophosphotriamic acid, thus:—

$$PCl_3O + 4NH_3 = PCl(NH_2)_2O + 2NH_4Cl, \text{ and}$$
$$2(PCl(NH_2)_2O) + 2H_2O = P_2(NH_2)_3HO_4 + NH_4Cl + HCl.$$

But, where a high temperature has been employed in saturating the oxychloride with ammonia, the product of the action of water is not the -triamic acid, but what I have called pyrophospho-pentazotic acid, $P_4N_5H_9O_7$.

Schiff's original view rested mainly on one determination

of phosphorus and nitrogen in his supposed phosphotriamide, which, however, gave numbers not very accordant with theory, while the phosphorus is nearly the same under either view. In his present note, he rests rather on the fact that the white powder, when heated *per se*, gives off ammonia without any chloride of ammonium, leaving PNO, and losing 36 per cent in weight.

My view rests on a large number of analyses of the two acids and their salts, and on the fact that, in my experiments, the oxychloride of phosphorus could never be made to increase in weight by the absorption of ammonia more than about 44 per cent, while a complete replacement of the chlorine would give 66·3.

It is evident that, under either view, ammonia without any chlorine must be given off when the white substance is strongly heated, and that phosphonitryl, PNO, is a probable result. I have already stated that pyrophospho-triamic acid, heated at low redness, gives off about 10 per cent of ammonia; and in an experiment, made for the purpose of determining how great a loss the substance would suffer when strongly heated, 16·85 per cent was all that could be obtained, and the black fused mass that remained in the tube was not pure phosphonitryl.

That Schiff should obtain a loss of 36 per cent would seem to indicate that he has produced some different compound from any of the acid amides, the formation of which has been my invariable experience.—I am, &c.,

J. H. Gladstone.

17, Pembridge Square,
Dec. 9, 1869.

LABORATORY NOTES.

AN EXPERIMENT

TO DEMONSTRATE INCREASE OF WEIGHT IN COMBUSTION.

There are two or three methods given in our text-books of demonstrating the increase of weight in combustion, and recently a novel one was described in the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin* (Chemical News, vol. xx., p, 71; *American Reprint, October, '69, page* 240). This method consisted in burning iron filings attached to a magnet, the magnet and filings being hung over the pan of a moderately delicate balance. While preparing this experiment, another form of it occurred to me, and this I have found to answer admirably; it has, however, the disadvantage of requiring a supply of oxygen from a bag or gas-holder. The experiment is made thus:—A small patty-pan, or the lid of a tin box, is put in one pan of a balance and counterpoised; then a piece of iron wire, or a knitting pin, is placed on the pan, and this also weighed or counterpoised. The wire is now burnt before the oxy-hydrogen blowpipe, the patty-pan being held underneath the burning wire to catch the globules of iron oxide as they melt off. When the wire is burnt as far as practicable, the patty-pan with the globules of iron oxide and the portion of unburnt wire, is put into the scale-pan, and it will be found there is a considerable increase in weight, due to the oxygen which has combined with the iron.

C. J. Woodward, B.Sc.

Midland Institute, Birmingham,
December 20th, 1869.

SULPHURETTED HYDROGEN APPARATUS.

The following apparatus for the production of sulphuretted hydrogen will perhaps be found useful:—

It consists of a wide-mouthed bottle, A, fitted with a sound cork having two holes; through one hole a short glass tube (similar to the tube through which air is blown in a common wash-bottle) is passed, projecting into the bottle about ¼ inch.

A second smaller bottle, B,—one that can be lowered into A—is also fitted with a cork having two holes; through one a U-shaped tube is passed in such a manner that one end may touch the lower surface of the bottle A, and the other that of B, when one bottle is within the other. That portion of the tube which touches the lower surface of the big bottle should be of India-rubber, to prevent breakage.

The small bottle, with its cork and tube, should now be lowered into the bottle A, and through the remaining hole in each cork a tube is to be passed which shall project into the bottle B, about ½ inch. All the holes through which the tubes pass should be lined with India-rubber tubing to render them air-tight.

To use the apparatus, remove the large cork, and it will necessarily bring away with it the small bottle with its tubes. Fill the bottle B, about three-fourths with acid sulph. dil.; fix its cork. Now place in the bottle A some sulphide of iron in lumps. Lower the small bottle till it rests on the bottom of A. Fix in the large cork. If air be now blown through the tube projecting into the bottle which contains the acid, the contents will be forced through the U-shaped tube into the bottle A, where it will mix with the sulphide of iron, and the gas will be evolved, which will escape through the tube opening into A. When sufficient gas has been obtained, by blowing through the tube by which the gas is escaping, the acid will again be forced through the U-shaped tube into A, and all action will cease. Powdered sulphide of iron must not be employed, because it would be carried back with the acid into the small bottle, where the action would be continued.

C. J. H. Warden.

December 20th, 1869.

MISCELLANEOUS.

Operatic Fireworks.—The manner in which scientific discoveries are applied to utilitarian or, at least, to money-making purposes in this material age is well illustrated in a stage effect obtained in the performance of "Faust" at the Grand Opera in Paris. The scene represents *Mephistopheles* in the act of tapping a great wine-vat, whereupon the stream flows like liquid fire, and, falling into the wine-tub, bursts into flame. Usually, the wine stream has been represented by a "squib," but, in the present instance, by very different means. A vessel for containing water was furnished at one side with a horizontal adjutage, and at the other, immediately opposite the adjutage, with an opening closed by a glass plate. The stream issuing from the adjutage, describing a parabola in its course to the tub below, a beam of electric light, directed through the glazed opening and the contents of the vessel, follows the course of the jet from point to point, so that the entire jet becomes luminous and sparkling, the red colour of molten cast-iron being communicated by making the glass through which the light is transmitted to the water of an orange-red tint. The fireworks ignited in the tub to produce the flame previously mentioned are believed to have been set off by pellets of potassium, fired by contact with the water in the manner very generally known. A foreign contemporary suggests that a similar application might be made of the recent discovery by Professor Nickels—that, if commercial chloride of copper be mingled with sulphide of carbon holding phosphorus in solution, the mixture will only smoke, whereas the addition of a little ammonia (either gascous or aqua ammonia) will insure its instantaneous bursting into flame. It was by means like this that, in the old times, sorcerers wrought their wonders to the astonishment alike of kings and people; but, in these days, the stage carpenter enables, for a few dimes, miracles to be witnessed for amusement that, a few generations ago, would have filled multitudes with awe.—*American Artisan.*

The Royal Society.—The annual meeting of the Fellows of this Society was held on the 30th Nov., at Burlington House. The President, Lieut.-General Sir Edward

Sabine, K.C.B., &c., delivered the inaugural address, in which he reviewed the progress which had been made in science during the year. The following gentlemen were afterwards elected on the Council for the ensuing year, viz.:—President—Lieut.-General Sir E. Sabine, R.A., K.C.B., D.C.L., LL.D. Treasurer—William A. Miller, M.D., D.C.L., LL.D. Secretaries—William Sharpey, M.D., LL.D.; George G. Stokes, Esq., M.A., D.C.L., LL.D. Foreign Secretary—Professor William Hallows Miller, M.A., LL.D. Other members of the Council—Frederick Currey, M.A.; Warren de la Rue, Ph.D.; Sir Philip de Malpas Grey Egerton, Bart., M.P.; Professor W. H. Flower, F.R.C.S.; William Huggins; John Gwyn Jeffreys; John Marshall, F.R.C.S.; Augustus Matthiessen, Ph.D.; Capt. Richards, R.N.; the Marquis of Salisbury, M.A.; C. W. Siemens; John Simon, F.R.C.S.; Archibald Smith, M.A.; Professor H. J. Stephen Smith, M.A.; Professor John Tyndall, LL.D.; and Professor A. W. Williamson, Ph.D. The Copley Medal was awarded to M. Victor Regnault, for his researches on the specific heat of gases and vapours, &c. A Royal Medal was awarded to Sir Thomas Maclear, the Astronomer-Royal at the Cape of Good Hope, for his measurement of an arc of the meridian. A Royal Medal was also awarded to Dr. Augustus Matthiessen, F.R.S., for his researches on the electrical and other physical properties of metals and their alloys. In the course of his remarks, the President said that Dr. Matthiessen's researches were distinguished, as well for their diversity as for their uniformly complete and trustworthy character, and referred, amongst others, to his investigation of the electric conducting power of commercial copper, which had resulted in very great improvement of the conducting power of the copper wire used in submarine telegraphy. After the meeting, the Fellows and their friends dined together at Willis's Rooms. The senior Fellow of the Royal Society is Sir John F. W. Herschel, Bart., D.C.L., who was First Wrangler and Smith's Prizeman at Cambridge in 1813, and was elected F.R.S. in the same year, being then only twenty-three years of age.

University of London.—*Second B.Sc. Examination (Examinations for Honours, B.A. and B.Sc. conjointly).*—Mathematics and Natural Philosophy: First Class. Richard Pendlebury, B.A. (scholarship), St. John's College, Cambridge.—Logic and Moral Philosophy: First Class. Matthew Robertson, B.A., New College; Walter William Rouse Ball, B.A., University College. Third Class. Arthur Clarke, B.A., Wesley College, Sheffield; Alfred Milnes, B.A., Manchester New College; James Greaves, B.A., private study; Frederick de Sola Mendes, B.A., University College; and Stephen Peter Hayes, B.A., Stonyhurst College, and Henry Keatley Moore, B.A., private study (equal). *(B.Sc. only).*—Chemistry: First Class. Alexander Muirhead, University College. Second Class. Charles Thomas Whitmell, St. John's and Trinity Colleges, Cambridge.—Geology and Palæontology: First Class. Charles Thomas Whitmell, St. John's and Trinity Colleges, Cambridge; Frederick Antony Potter, Royal School of Mines.—Zoology: First Class. Phineas Simon Abraham, Trinity College, and Royal College of Science, Dublin. Second Class. William Henry Johnson, University College.

The Quekett Microscopical Club.—We understand that Mr. Suffolk will repeat his course of lectures "On Microscopical Manipulation" in January, 1870. Gentlemen wishing for particulars can apply to the Secretary.

The Faraday Memorial.—The subscriptions to the Faraday Monument Fund, received up to Dec. 7, amount to £1400. The object of the fund is to provide a public memorial to Faraday, and the subscription from one person is not to exceed five guineas.—*Nature.*

Royal Institution of Great Britain.—The following are the arrangements for the Friday Evening Meetings before Easter, 1870:—

Jan. 21st. Professor Tyndall, LL.D., F.R.S., M.R.I.—"On Haze and Dust."

Jan. 28th. Professor Odling, F.R.S.—"On Professor Graham's Scientific Work."

Feb. 4th. Professor Ruskin, M.R.I.—"A Talk respecting Verona and its Rivers."

Feb. 11th. W. B. Carpenter, M.D., F.R.S., &c.—"On Temperature and Life in the Deep Sea."

Feb. 18th. William Kingdon Clifford, Esq., B.A.—"On Theories of the Physical Forces."

Feb. 25th. Colonel Sir Henry James, F.R.S.—"On the Results of the Excavations at Jerusalem, and on the Recent Survey of Sinai."

March 4th. E. J. Reed, Esq., C.B., Chief Constructor of the Navy.—"On Iron-clad Ships."

March 11th. Professor Sylvester, M.A., LL.D., F.R.S.—"On Chance."

March 18th. Peter W. Barlow, F.R.S.—"On the New Thames Tunnel."

March 25th. Professor Rolleston, M.D., F.R.S.—"On History of the Fourth, Fifth, and Sixth Centuries in England, as Illustrated by Researches into the Modes of Sepulture then Practised."

April 1st. Professor Roscoe, F.R.S.

April 8th. Professor Huxley, F.R.S.

Examination of Petroleum.—We have received from the committee of the Mineral Oil Association, to which Dr. Paul is consulting chemist, a statement of results obtained in the examination of 75 samples of petroleum and other kinds of mineral oil purchased in the ordinary course from retail dealers in the Metropolis, which show—(I.) That one-half of the oil represented by these samples is petroleum within the meaning of the Act (31 and 32 Vict., cap. 56); (II.) That it gives off inflammable vapour at a temperature below that specified by the Act as the minimum for ensuring safety in the stowage and sale of such oil; and (III.) That there is still a very general and habitual disregard of the provisions of the Petroleum Act. A portion of each sample of oil tested has been preserved at the office of this Association.

Uses of Aluminate of Soda.—The white opaque glass (semi-porcelain) of which the French gas globes are often made is manufactured in various ways. Hitherto kryolite (fluoride of aluminium and sodium) has been found to answer best for the manufacture of the opaque white glass, but it seems now destined to be supplanted by aluminate of soda. In the application of the latter, no fluorine compounds are evolved which act very much on the substance of the melting pots. 1 cwt. aluminate of soda is equal to 1¼ cwts. kryolite and 1-10th cwt. calcined soda in the mixture for making that kind of glass. The aluminate, as manufactured by kryolite-soda makers, is quite free from iron, which is never the case with kryolite itself. Other applications of the new manufacture are in dyeing and print works; as a mordant in soap making, where white and heavy soap is required; in precipitating dyeing lakes, &c. Very likely the applications of this product will become more numerous as it becomes better known.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Comptes Rendus des Séances de l'Académie des Sciences, November 22, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Spectrum of the Planet Neptune, and some Observations on Spectrum Analysis.—Rev. Father Secchi, S.J.—The author first refers briefly to his former observations of the spectrum exhibited by Uranus, and then mainly states that the spectrum of Neptune consists chiefly of three lines, or bands, placed near the green line, and that its light is entirely devoid of red; this is confirmed by the colour exhibited by the planet when seen through a telescope, which is a sea-green. The same author states that, though the night of the 14th of November last, at Rome, was not very favourable for observation of asteroids, on account of the somewhat cloudy sky, he had been enabled to notice more than 180 asteroids during one hour.

Heat given off by the Moon's Rays.—M. Zantedeschi.—From this paper, which is chiefly a review of what has been done by this and other authors in this direction, we learn that, as far back as the years 1685 and 1781, the Italian *savants*, Geminiano, Montanari, and Paolo Frisi, proved the existence of rays of heat emitted by the moon, by means of lenses and ordinary thermometers. The author refers to his observations made some twenty years ago, when he applied thermo-electric apparatus, as well as spirit thermometers and lenses, and obtained results fully confirming those made and recorded by the Italian *savants* just alluded to.

Colouration of Glass under the Influence of Direct Sunlight.—M. Bontemps.—The author, who is the managing director of the celebrated crystal glass works at Choisy le Roi, states, after referring to the observations on this subject made by the immortal Faraday, in 1824, and MM. Gaffield and Pelouze, in 1863 and 1867, that his observations lead to the following results:—Within three months after having been exposed to sunlight, the best and whitest glass made at St. Gobain is turned very distinctly yellow; extra-white glass (of a peculiar mode of manufacture) has become even more yellow, and gradually assumes a colour known as *pelure d'oignon;* glass containing 5 per cent of litharge was also affected, but far less perceptibly; crystal glass, made with carbonate of potassa (the other varieties referred to contain carbonate of soda), litharge, and silica, was not at all affected; English plate-glass, made by the British Plate-Glass Company, and exhibiting a distinctly azure-blue tinge, remained, also, unaffected. The author attributes this colouration, which begins with yellow and gradually turns to violet, passing through red *pelure d'oignon*, to the oxidising effects of the sun's rays upon the protoxides of iron and manganese contained in glass.

Physical Properties of Arable Soil.—M. Hervé-Mangon.—This paper is divided into the following sections:—Microscopical examination of arable soil; determination of the calorific properties of arable soil; condensation of gas in soils; diffusion of gas through soils; tension of aqueous vapour in soils.

Copper Mines of Lake Superior, and Discovery of Tin in the State of Maine, U. S.—M. Jackson.—In the shape of a letter, written by the author to M. Elie de Beaumont, the author states that, in June last, there was found in the Phœnix copper mine, near Lake Superior, a mass of native copper measuring $65 \times 32 \times 4$ feet, weighing 1000 tons, and valued at 400,000 dollars. In some parts, this mass has, instead of its average 4 ft, 7 ft. thickness. As to the site where the tin ore has been discovered, the author states that he received a sample, sent to him from Winslow by a Mr. Moore, and that, on analysis, he (M. Jackson) found the ore to yield, in its crude state, 46 per cent of pure tin, and after washing, about 75·5 per cent. There exist some forty mineral veins containing the ore, and these veins are workable.

New and Important Works.—M. E. de Beaumont.—In his capacity as one of the perpetual secretaries, the author calls particular attention to two works—viz., that of the illustrious geologist and vice-president of the Belgian Senate, M. Omalius d'Halloy, "On the Human Races, or Elements of Ethnography," which is highly eulogised for its clear and distinct language and simplicity of reasoning; and the work of M. Burmeister, "The History of Creation," which has now reached its seventh edition, and is translated into no less than seven different languages, the original being written in German. The eminent perpetual secretary above named speaks of this work as a most masterly exposition of scientific truths placed before the public in a very attractive and pleasant shape.

Revue Hebdomadaire de Chimie, November 11, 1869.

The number contains the following original matter:—

Powders to which Aniline Colours are Added.—M. Mène.—It appears that there are met with in the trade, a series of powders, of comparatively inert nature, with which aniline colours are incorporated. The author says—These substances are chiefly starch, which has been made to absorb alcoholic solutions of the different aniline dyes, and the coloured powders so obtained are employed in the manufacture of coloured printing-inks. As an improved method of the manufacture of such powders (the author says), I employ the following process:—Dissolve, in ½ a kilo. of 95 per cent alcohol, 10 grms. of copal resin and 1 grm. of magenta red; filter the solution, and incorporate therewith, afterwards, so much dry starch as will form a friable uniformly-coloured mass. The mixture is dried in a properly-constructed drying apparatus, and next ground to powder. When a violet tinge is desired, only half the quantity of magenta-red is applied, and the other half replaced by ultramarine. The addition of copal has the effect of fixing the colouring matter to the starch.

A New Kind of Burette.—M. Gondolo.—This piece of apparatus consists essentially of the graduated tube generally applied; but it is improved upon in the following manner:—The internal conical opening at the bottom is shut by a very carefully-ground-in glass plug of conical shape. To this plug is soldered a glass rod, running through the length of the graduated tube, and passing through a cork at the top; in the cork, a spring has been ingeniously placed, in such a manner as to force the glass rod down, and keeping the plug tightly fitting the opening at the bottom. When it is desired to use the burette, which is, of course, firmly fixed in a proper stand, the hand of the operator lifts the end of the glass rod, which projects outside the cork, for a moment, and, on releasing the action of the hand, the plug is shut again by the action of the spring. Provision is made for the admittance of air, of course; and, according to the author's statement, this kind of burette is now very generally in use in France and Germany, and giving great satisfaction to all who use it.

Detection of Adulterations of Soft Soap.—M. Arbelier.—Soft soap is frequently adulterated by the addition of from 20 to 25 per cent of raw starch, with the view of giving to the soap an appearance which, if genuine, is due to solid stearates formed therein. The microscopic investigation will, of course, readily detect this fraud; but if it is required to apply a chemical test, the author states that 10 grms. of the sample of soap should be taken and dissolved, without the application of heat, in alcohol of 85 per cent; the soap, if unadulterated, will be readily dissolved, leaving no residue. If any residue is left, it can be tested by the well-known methods for starch, as well as for other impurities. Lime is sometimes present.

Trade in Flowers Used for Perfumery.—M. Contet.—From this paper we abstract the following:—In order to obtain, by distillation, 1 kilogramme of the undermentioned essential oils, the annexed quantities of parts of plants are required:—Neroli, 100 kilos. of orange blossom; roses, from 10 to 30,000 kilos. of petals of roses; petitgrain, about 500 kilos. of the leaves of the orange-tree; mint, about 500 kilos. of leaves; lavender, about 250 kilos. of flowers; geranium, about 2,000 kilos. of the leaves. The extent of the trade of some of these articles may be inferred from the fact that the neighbourhood of Nice alone produces annually a

value of £8000 of one single kind of flower, the well-known sweet-smelling Nizza violet. The leaves of the orange-trees are valued at about 20 francs per 100 kilos. Among the perfumes more generally known in Southern than in Northern Europe belongs the *cassies* (*Acacia farnesiana*), frequently used by both French and Spanish ladies to impart a pleasant perfume to their linen.

November 18, 1869.

Preparation of Gilders' Glue.—M. Totin.—Rabbit skins are cut up to shreds as small as vermicelli, and boiled for some time on a water-bath after previous addition of a sufficient quantity of water. The fluid is separated from the portion of the skin insoluble in water by passing through a sieve; and to the fluid, while yet hot, is next added a solution of 100 grms. of sulphate of zinc, and 25 grms. of alum, previously dissolved in pure and boiling water. The mixture is thoroughly stirred up, and again filtered through a fine sieve; after this, the clear fluid is poured into a suitable vessel, and left to solidify, which takes place after twenty-four hours in winter and forty-eight in summer. When the solidification is complete, the gelatinous mass is cut up into oblong squares and dried, as is usual with glue. When required for use, the dry glue should be soaked first, for about ten hours, in cold water, and next melted by the aid of a water-bath. 1 kilo. of this dried glue yields a thick solution with from 8 to 10 litres of water.

Preparation of Albumen from Blood.—M. Dolfus-Galline.—The increasing demand for albumen, especially for the use of calico-printing (fixing of pigment and other colours), has at various times led to attempts to obtain a supply of this article from the blood of slaughtered oxen and sheep. The author of this paper describes at great length a process invented by him, and actually in operation on the large scale at the *abattoirs* of Dornach, France. The process is based upon the fact of the coagulation of the so-called cruor of the blood, and its separation from the serum thereof, the latter yielding, by cautious management, a dried albumen which can be applied instead of egg albumen for clear and bright colours, while the former may be manufactured into an albumen suitable for dark pigments. 10 litres of serum yield 1 kilo. of dry colourless albumen, and the blood of two-and-a-half oxen yields just sufficient serum to obtain this quantity of albumen; the blood of ten sheep and seventeen calves also produces the same quantity of dry albumen, viz., 1 kilo.

Gas Aerifuge.—M. Rouillé.—The author describes and elucidates by a woodcut an apparatus suitable to manufacture gas from the essence of petroleum. In reality, the gas is simply atmospheric air saturated with the vapour of that essence and conducted through pipes. From experiments which are described in this paper, and which appear to have been fairly and scientifically conducted with impartiality, this mode of gas-lighting is fully 21 per cent cheaper than the use of coal-gas, in Paris, for equal illuminating power. The vapour-gas, however, yields a better light; its illuminating power is far greater, for equal consumption, than that of coal-gas, and the products of its combustion are completely free from sulphur and ammonia. The apparatus are simple and efficient, and may be inspected in operation at No. 211, Rue Lafayette, Paris, where, on every Tuesday and Friday evening, the public are admitted to a room purposely fitted up for photometrical and other experiments.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 201, September, 1869.

This periodical contains the following papers and communications bearing upon chemical subjects:—

Researches on the Bleaching of Woven Tissues.—M. Kolb.—There exists in the linen fibre, along with cellulose, two distinct substances—one of these is pectic acid, which is readily and very completely eliminated by alkalies; the other is a colouring substance, which is generated during the roating of the flax, giving thereto a greyish hue, and resisting the solvent action of all known solvents, and only separable from the cellulose by dissolving the latter in the ammonio-copper solution. While the quantity of pectinic products amounts in flax to from 15 to 36 per cent, this greyish matter is present therein in infinitesimal small quantity. Chlorine and hypochlorites discolour this substance, but do not dissolve it; perfect bleaching consists, therefore, in two operations—(1) elimination of all yellow colouring matter by means of alkali; (2) oxidation, and hence decolouration, of the greyish matter, which does not, however, as is generally assumed, thereby become soluble in alkalies. The author proposes the use of dilute liquid ammonia as the best so-called antichlorine, and also because it is simultaneously antacid.

Preservation of Butchers' Meat.—M. Gorges.—The process in use on the large scale by the author at Monte-Video is, briefly, as follows:—The meat, in pieces weighing from 2 to 50 kilos., is placed in a mixture of water (85 per cent), the rest being hydrochloric acid, glycerine, and bisulphite of soda. After having been steeped for some time, the pieces are taken out and dusted over with finely-powdered dry bisulphite of soda, and then packed in air-tight boxes filled as full as possible. In this state, the meat keeps fresh any length of time, and becomes perfectly fit for use—equal to fresh butcher's meat—by steeping for a short time in water to which vinegar has been added, and afterwards exposure to air. The author manufactures, at the place above named, an excellent extract of meat, which can be sold in Europe at 6 francs per kilo.; the price of the preserved meat, of which it would be easy to supply to London and Paris daily over 10 tons, is from 50 to 60 centimes per kilo.

Purification of Sewage Water.—M. Durand-Claye.—From this lengthy paper we quote the fact that the mother liquor of the manufacture of sulphate of alumina clarifies and purifies the liquid in question better than any other substance tried by the authors on the large scale. The expense only amounts to 0·0125 franc per cubic metre of fluid (rather more than 35 English cubic feet).

Cosmos, November 20, 1869.

This number contains the following original matter relating to chemistry and allied sciences:—

Analysis of the Meteorite of Deesa.—M. Domeyko.—This meteorite was observed in Chili, near Santiago, and the author, Inspector-General of Mines to the Republic alluded to, gives, in a lengthy paper, the following chemically-interesting particulars:—The metallic portion of the stone has, at 11°, a specific gravity of 7·51, and consists, in 100 parts, of—Iron, 87·17; nickel, 8·75; insoluble silicate, 2·40; phosphuret of iron and nickel, 1·42. The stony part of this meteorite is exceedingly hard, scratches glass readily, and is not scratched by hardened steel, and assumes a brilliant polish. The sp. gr. of this substance is, at 12°, =3·589; it contains 12·62 per cent of nickeliferous iron. 58·45 per cent is soluble, and 41·55 per cent not soluble in HCl. The insoluble portion consists of—Silica, 18·64; magnesia, 17·89; protoxide of iron, 5·71; traces of soda and alumina; nickeliferous iron, 12·62; troilite, sulphide of iron of meteorites, a peculiar protosulphide of iron, 5·01 (we quote the original exactly, but the total adds up to 59·87, as it is given there). The portion soluble in acid consists of—Silica, 20·79; magnesia, 9·70; protoxide of iron, 6·99; lime, 1·45; trace of soda; alumina, 2·27; peroxide of iron, 0·41; with traces of sesquioxide of chromium, phosphorus, and carbon. The insoluble portion approaches the composition of the peridote, and the soluble portion that of pyroxenic minerals.

Lectures at the Conservatoire des Arts et Metiers, Paris.—While the requirements of technical education are often discussed, many of our readers will, perhaps, be interested with the following list: Geometry applied to arts; descriptive geometry; mechanics applied

to arts; civil architecture; applied natural philosophy; applied chemistry; industrial chemistry; the chemistry of dyeing, glass making, and ceramic art; agricultural chemistry; lectures on the theory of agriculture; agricultural engineering; spinning and weaving; political economy and industrial legislation; industrial economy and statistics. Among the lecturers are MM. Becquerel, Peligot, Tresca, Payen, de Luynes, Boussingault, &c.

Mineral Substances Applied for Staining Glass and Porcelain.—M. Meunier.—The colours applied to porcelain and glass are in reality coloured glasses, which are burnt into the mass of the white glass or china. As regards the latter, in most cases, after it has been glazed, since most of the substances used as colouring matter do not stand a very strong heat (technically, in French, *grand feu*)—that is to say, the heat at which the porcelain is fired—the burning-in of the colours is effected in muffles. As colouring matters for porcelain are used—Peroxide of iron for red (brick), brown, violet, yellow, and sepia; oxide of chromium for green; oxide of cobalt and nitrate of protoxide of cobalt and potassa for blue and black; oxide of uranium for orange and black; oxide of manganese for violet, brown, and black; oxide of iridium, for deep-toned black; oxide of titanium for yellow; oxide of antimony for yellow; black oxide of copper for green, and red oxide (suboxide) of copper for red; chromate of lead for yellow; chromate of baryta for yellow; chloride of silver for red; chloride of platinum, and chloride of platinum and ammonium, for steel-colour (in fact, metallic platinum); purple of cassius for purple and rose-red colour. Only the following substances stand, without deterioration or volatilisation, the highest heat of the porcelain furnace (they are *couleurs grand feu*):—The oxides of uranium, cobalt, chromium, manganese, iron (peroxide), and titanium. Most of the substances mentioned are not used as such in pure state, but require either to be mixed very intimately, often by a previous ignition with various fluxes, or, also, with other substances, to produce the required hue and shade of colour. The chemistry of the colouring matters required by the artists who paint on porcelain is one of the most difficult and intricate portions of the application of that science to art.

Bayerisches Industrie und Gewerbeblatt, September, 1869.

Among the official announcements in this number, we notice the *series lectionum*, or programme of the winter session of the Royal Polytechnic School at Munich, containing the following sections:—Mathematical sciences; natural sciences; engineering and architectural science; mechanico-technical science; chemico-technical sciences; general class, including modern foreign languages; drawing class.

Police des Mines et Carrieres.—An excellent model of the rules and regulations to be observed for the safety of the working of mines and quarries.

Central Air-Heating Stove.—M. Broc.—There is added to this excellent paper a series of drawings. The stove is designed for heating large buildings, as well as private dwellings, keeping up throughout every part thereof a uniform heat at very little expense.

Precautions Required to be taken by those who Work with Mercury.—Dr. Pappenheim.—This paper is the first instalment of a lengthy memoir on the subject of the volatility of mercury, and on tests for its presence in the atmosphere, especially of workshops. It appears that living plants are so highly sensitive to vapors of mercury that they are the best tests for the purpose of detecting even very minute quantities of the vapors of that metal, especially when the plants are young. The effect of mercury upon plants is the decolouration of all the green parts, especially the leaves.

Utilisation of Scraps of Tinned Iron.—M. Bock.—The scraps are placed in a tank made of stout sheet iron. To 1 cwt. of scraps, 6 lbs. of flowers of sulphur, 10 lbs. of caustic soda, and a quantity of water are added, and the mixture brought to ebullition by means of steam, introduced into the tank by means of a suitable pipe. The boiling is continued for about half an hour; the liquor is filtered, evaporated to dryness, and ignited with access of air. The ignited mass is lixiviated with water, yielding stannate of soda and sulphate of soda, which are separated from each other by their different degree of solubility; both salts crystallise.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, September. 1869.

This number contains the following original papers and communications:—

Some Little-Known Poisonous Mexican Plants belonging to the Order of Compositæ.—Dr. Huseman.—It appears that the plant known as *Itz cuimpatli, Yerba de Puebla, Senecio canicida*, has been submitted to a chemical investigation by the Mexican chemist, De la Loza; he detected a peculiar organic acid, which he called senecic acid. This acid should, according to this chemist, possess poisonous properties; it forms, with potassa and ammonia, deliquescent salts; neither the acid itself, nor its alkaline salts, are precipitated by the soluble salts of lime, magnesia, mercury, silver, copper, and platinum. The acid is soluble in alcohol, and is obtained by treating a decoction of the plant with acetate of lead and removal of the excess of lead by means of dilute sulphuric acid; the fluid so obtained, after filtration, is evaporated to the consistency of a syrup, and left standing for a few days. The acid separates in small, but deliquescent crystals; these are collected, and purified by treatment with strong alcohol. The acid and its salts are very poisonous; but the plant and its alcoholic extract are used in Mexico as a powerful febrifuge and anthelmintic.

Contributions to the Search for, and Detection of Blood-Stains.—M. Hirsch.—There is nothing in this paper which is not well known to all who, in their capacity as forensic chemists, may have to deal with this subject.

Testing Antimony for Arsenic by the Moist Way.—M. Rump.—The author states—During the latter end of last year, on the occasion of the inspection of apothecaries' shops in Prussia, a quantity of tartar emetic was found to contain arsenic; as a consequence thereof, a report was made to head-quarters, at Berlin, and a rigorous inquiry and investigation set on foot by order of Dr. de Mühler, as minister for medical affairs and police (*medizinal polizei*). The methods of testing for arsenic, when mixed up with antimonial preparations, were carefully considered, and the following method of testing, due to the researches of Mine Inspector Strohmeyer, adopted:—2 grms. of the suspected tartar emetic are reduced to a fine powder and dissolved in 4 grms. of pure hydrochloric acid (sp. gr., 1·124). The glass vessel wherein this solution is made ought to be narrow, and capable of being well closed, and of sufficient size to contain an additional quantity of at least 30 grms. more of hydrochloric acid. A quantity of pure hydrochloric acid should be thoroughly saturated with sulphuretted hydrogen gas, and of this acid a quantity of at least 30 grms. is added to the solution of the tartar emetic. The glass vessel containing the solution is well corked, and after having been shaken up, set aside; the turbidity which at first appears soon subsides (if it does not do so, it is due to the too great saturation of the HCl with HS, and should be remedied by the addition of some pure HCl). If no arsenic is present at all, the liquid remains perfectly colourless; but the slightest trace of arsenic gives rise to a yellow colouration, and very soon after to a perfectly perceptible pure yellow precipitate of sulphuret of arsenic.

Zeitschrift für Chemie von Beilstein, No. 20, 1869.

On Phosphamides.—M. Schiff.—After briefly referring to his former experiments on this subject, and com-

menting, in a few words, on Dr. Gladstone's treatise on the action of ammonia upon oxychloride of phosphorus, the author says—When perfectly dry ammonia gas is brought into contact with oxychloride of phosphorus, so much heat is at first set free that it is necessary to moderate the action considerably; but it is not possible to eliminate the whole of the chlorine, unless the product first obtained be repeatedly treated with ammonia. The chloride of ammonium can be removed by hot water, since neither that fluid, nor, also, dilute acids, have any decomposing effect upon the triamide thus formed. When phosphotriamide is heated without access of air, it is converted into monophosphamide, NPO, the loss of weight amounting to about 36 per cent. It is clear that only ammonia is disengaged, and no vapours of chloride of ammonium are detected at all, which would certainly make their appearance if a chlorinated amide were dealt with. When phosphoric acid is considered as—

$$P\begin{Bmatrix} O.OH \\ OH \\ OH \end{Bmatrix}$$

and the oxychloride of phosphorus as—

$$P\begin{Bmatrix} O.Cl \\ Cl \\ Cl \end{Bmatrix}$$

the meaning is that one of the atoms of chlorine has a different chemical function than the two other atoms; and it is just possible that that very one atom is less readily acted upon than the rest. When pentachloride of phosphorus is suffered to act upon aniline, a rather violent reaction takes place; but, with careful management, a whitish-coloured substance, insoluble, and thereby undecomposable in cold water and dilute acids, is obtained; when, however, this substance is boiled with water, it is split up, and phosphate of aniline is among the products of decomposition. The original product is phosphodianilide—

$$N_2\begin{Bmatrix} PO \\ 3C_6H_5 \end{Bmatrix}$$

and its formation is represented as follows:—1. First action of aniline and pentachloride of phosphorus—

$$PCl_5+3C_6H_7N=N_2\begin{Bmatrix} PCl_2 \\ 3C_6H_5 \end{Bmatrix}+NH_4Cl+2HCl.$$

2. On being next treated with water—

$$N_2\begin{Bmatrix} PCl_2 \\ 3C_6H_5 \end{Bmatrix}+H_2O=N_2\begin{Bmatrix} PO \\ 3C_6H_5 \end{Bmatrix}+2HCl.$$

Cyantoluylen.—M. Irelan.—The author has investigated the behaviour of chlorotoluol-sulphate of potassa towards cyanide of potassium. When an intimate mixture of these salts is heated, a sublimate is obtained, exhibiting, after recrystallisation from alcohol, a solid substance forming needle-shaped crystals composed according to the formula—

$$C_9H_6N_2=C_7H_6\begin{Bmatrix} CN \\ CN \end{Bmatrix}$$

On being boiled with a solution of caustic potassa, ammonia is given off, and if, afterwards, sulphuric acid is added, a dicarbon acid (*dicarbonsäure*) is precipitated, which acid is, in all probability, uvitinic acid. Dichlorotoluolsulpho acid yields, when submitted to the same treatment, a cyanised compound.

Behaviour of Epichlorhydrine towards Neutral Sulphate of Potassa and Cyanide of Potassium.—M. Pazschke.—On mixing 1 molecule of epichlorhydrine and 1 molecule of K_2SO_3 in concentrated aqueous solution, and boiling the mixture, a deep yellow-coloured, acrid-smelling fluid was obtained, which solidified on cooling, yielding a crystalline compound, which, after having been repeatedly recrystallised, yielded a salt, $C_3H_6S_2O_7K_2+2H_2O$; that is to say, disulphoglycerinate of potassa. The reaction of neutral sulphate of potassa upon epichlorhydrin is rather complex, and exhibits two different stages:—

1. $\begin{matrix} CH_2 \\ CHl^3O \\ Cl \end{matrix}\Big\}C+2\left(\begin{matrix} KO \\ KO(SO) \end{matrix}\right)=\left\{\begin{matrix} CH_2K \\ CHl^3O \end{matrix}\right\}C\left(\begin{matrix} SO_2 \\ SO^2 \end{matrix}\right)OK\Big\}+KCl.$

2. $\left.\begin{matrix} CH_2K \\ CH^3O \end{matrix}\right\}C\left(\begin{matrix} SO_2 \\ SO_2 \end{matrix}\right)OK\Big\}+H^2O=\left\{\begin{matrix} CH_3 \\ CH_3O \end{matrix}\right\}C\left(\begin{matrix} SO_2 \\ SO_2 \end{matrix}\right)OK\Big\}+KOH.$

When 20 grms. of epichlorhydrine were gently heated along with an aqueous solution of cyanide of potassium (15 grms. KCy, and 60 grms. H_2O), a rather violent reaction sets in; but, with proper management, a crystalline compound is obtained, which is readily dissolved by water and alcohol, but sparingly by ether; this substance is composed according to the formula C_4H_6NO.

Identity of Dichlorhydrine obtained from Glycerine and Epichlorhydrine.—The author has compared dichlorhydrine, prepared by passing hydrochloric acid gas into a mixture of four parts of glycerine and three parts of glacial acetic acid, with the dichlorhydrine prepared by passing hydrochloric acid gas into epichlorhydrine. The former boils at from 176° to 177° and has a sp. gr. of 1·366 at 17·5 ; the latter boils at from 175° to 176°, and has, at 17·5°, the very same density as just mentioned. They are both equally soluble in water.

Dicyannaphthaline.—MM. Baltzer and Merz.—When dipotassium-disulphonaphthalate is submitted to distillation with excess of cyanide of potassium, a fluid is obtained which solidifies in the neck of the retort. This crude substance contains two dicyannaphthalines, of different solubility in alcohol. The more readily soluble of the two exhibits, after having been purified, a silky-looking, needle-shaped, crystalline mass, devoid of taste and smell, and fusing at 181°; this substance is completely decomposed at about 200°, and the action of either aqueous solution of caustic potassa or hydrochloric acid yielding, in each instance, naphthalin-dicarboxylic acid, a beautifully crystalline compound. The other dicyannaphthaline, far less soluble in alcohol (boiling only), fuses at 260°, is a crystalline compound, and undoubtedly identical with a substance obtained by MM. Darmstädter and Wichelhaus from dinaphthalin-disulpho acid.

Isomeric Cresoles and their Derivatives.—MM. Engelhardt and Latschinoff.—This lengthy memoir opens with an introduction reviewing the labours of so large a number of scientific chemists who have experimented on this subject, that their names alone would fill a too considerable space. Of the paper itself, we can only give the titles of the headings of its different sections: Isomeric toluolsulpho acids, $C_7H_7(HSO_3)$; *a* and *β* toluolsulpho salts; isomeric cresoles, C_7H_8O; *a* cresole; *a* benzoyl-cresole, C_7H_7O (C_7H_5O); *a* ethyl-cresole; *a* cresol-sulpho acid; *a* cresol-sulpho potassium, $C_7H_6(KSO_3)OH+2H_2O$, and a series of similar salts of various bases; *a* cresol-disulpho acid; *a* cresol-disulpho-potassium—

$$C_7H_6(KSO_3)_2OH+3H_2O;$$

β cresole, C_7H_8O; *β* benzoyl-cresole; *β* cresol-sulpho acid; *γ* cresole, C_7H_8O; *γ* benzoyl-cresole, $C_7H_7O(C_7H_5O)$; *γ* ethyl-cresole; *γ* cresol-sulpho acid; isomeric cresotinic acids, $C_8H_8O_3$; isomeric toluylic acids. The memoir is an abstract from a very lengthy paper published in the Russian language, and is so full of formulæ and references to different papers published on this subject that it is not possible to enter into more details here.

Some of the Products of Decomposition of Trichloromethylsulphurous Acid.—M. Loew.—When trichloromethylsulphonbromide is submitted, in alcoholic solution, to a temperature of about 110°, while enclosed in a sealed tube, and the contents of the tube are next diluted with water, a heavy oil is separated, while the supernatant liquid contains free sulphurous acid; this reaction takes place according to the following equation:—

$$\underbrace{(CCl_3)[SO_2]Br}_{\text{Trichloromethyl-sulphonbromide.}} = \underbrace{CCl_3Br}_{\text{Carbontrichloro-bromide.}} + SO_2.$$

[English Edition, Vol. XX., No. 523, pages 275, 276.]

Along with the sulphurous acid, a small quantity of trichloromethylsulphonic acid is detected. Carbontrichlorobromide boils at 98°, and is, when passed through a dull red hot combustion tube, decomposed into bromine and solid chloride of carbon. The author did not succeed in obtaining the analogous iodide; neither did he obtain a trichloromethyl-sulpho urea. While attempting to prepare dichloromethylensulphon, by submitting trichloromethylsulphinate of sodium to destructive distillation. according to the formula—

$$(CCl_3)[SO]ONa = NaCl + (CCl_2)[SO_2],$$

a very small quantity of that substance was obtained; but the reaction went further, and other substances, among which, perchloride of ethylen, were obtained, this reaction being represented by—

$$2((CCl_2)[SO_2]) = 2SO_2 + C_2Cl_4.$$

Action of Direct Sunlight upon Iodide of Potassium.—M. Loew.—A solution of iodide of potassium is, even when kept in well-closed bottles, slowly decomposed by the action of daylight, and assumes a somewhat yellowish tinge, due to free iodine. The author filled a number of glass tubes for about from one-half to three-fourths of their capacity, with a solution of iodide of potassium, and, after having sealed these tubes, exposed them to direct sunlight. Another set of tubes were likewise filled with the same solution, but all air was expelled, and the tubes sealed during and after the solution had been boiling for a considerable time. These tubes were also exposed to the action of direct sunlight; after three and four months' exposure, the tubes and contents were examined; those wherein no air at all was left were found to be perfectly colourless, no decomposition of the contents having taken place. As regards the other tubes, the following results are noticed:—(1) Under the influence of light, the oxygen of the air decomposes iodide of potassium, iodine in small quantity is set free, while hydrate of potassa is found in the liquid. (2) This decomposition is limited, and does not, even when a large quantity of oxygen is present, increase, because a portion of the iodine set free enters again into combination with the caustic potassa set free, forming iodide of potassium and iodate of potassa. (3) The testing for ozone by means of a solution of iodide of potassium and starch (or paper prepared therewith) is of no value whatever, unless care has been taken to exclude direct sunlight.

Precipitation of Cobalt by Sulphuretted Hydrogen, and Purification of Salts of Manganese containing Cobalt.—M. Muck.—The gist of this paper is that boiling-hot solutions of cobalt are, even when free acid is present, readily precipitated by sulphuretted hydrogen. When there is added to such a solution carbonate of manganese, in sufficient quantity, the sulphide of cobalt is completely precipitated, and, after elimination of the free HS, a pure solution of manganese is obtained. The author also states that there occur many ores of manganese which contain large quantities of cobalt ore.

Phenol from Oxybenzoic Acid.—M. Rosenthal.—The author has prepared phenol by distilling oxybenzoic acid with lime; and on investigation, found it to be in all respects identical with the phenols obtained from tar, salicylic acid, and paraoxybenzoic acid.

Ethyloxybenzoic Acid.—M, Rosenthal.—The author says—I tried to prepare, from oxybenzoic acid, an acid of the formula—

$$C_6H_3\begin{cases}OH\\COOH\\COOH\end{cases}$$

by causing carbonic acid and sodium to act upon the compound

$$C_6H_4\begin{cases}OH\\COOC_2H_5.\end{cases}$$

Instead of obtaining the desired result, the author obtained the compound—

$$C_6H_4\begin{cases}OC_2H_5\\COOH\end{cases}$$

which is undoubtedly due to the conversion of Na and C_2H_5; this substance is ethyloxybenzoic acid, and was, on comparison, found to be in every respect identical with the compound obtained by heating oxybenzoic acid with KHO and C_2H_5I.

Les Mondes, November 18, 1869.

Refined Resin Oil.—M. Curie.—When resin is submitted to destructive distillation, it yields various oils of different specific gravity, acetic and phenic acids, water, tar, and gases; the crude oil is often applied for the making of printing-ink, as well as waggon grease. The author treats the crude oils, tar inclusive, with lime, and, by fractioned distillation between 140° and 260°, obtains what is known as essence of resin. At 370°, an oil is obtained which, for lubricating purposes, is nearly as good as best olive oil, and is an excellent substitute for turps in oil-paints. This oil is sold at Bordeaux at fifty francs (£2) per 100 kilos.

Treatment of the Sewage of the City of Rheims.—MM. Houzeau, Devédeis, and Holden.—In a lengthy paper, the authors detail the results of a series of experiments made on a sufficiently large scale to form a proper opinion as to the value and permanent applicability. The processes which have been applied are: (1) Treatment with sulphate of iron and lime; (2) treatment with lignite and lime; (3) treatment with small coal (dust, rather) and a small quantity of sulphate of iron and lime. The two first processes yield a manure; the last a fuel. The city of Rheims is situated on and near the banks of the Vesle, and contains, exclusive of the large garrison, a population of about 61,000 inhabitants. According to a report of M. Maridort, Professor of Chemistry at this place, the process, by means of the use of lignite, is a complete success.

Comptes Rendus des Séances de l'Académie des Sciences, November 29, 1869

This number contains the following memoirs and papers relating to chemistry and allied sciences:—

Construction of an Optical Plane.—M. Foucault.—It appears that M. A. Martin has found, among the papers left by the deceased author, a short note on the proper means to realise the construction of an optical plane—that is to say, a plane surface so perfect that the reflected ray of light in no respect differs from the incident ray.

Improving Wine by Electricity.—M. Scoutetten.—The author states that the accidental striking of lightning on the house of a vineyard proprietor caused the rupture of several large hogsheads containing wine, which found its way into a cavity existing in the cellar of the house. The owner imagined his wine lost and spoiled, but found, to his astonishment, that the wine, instead of having been deteriorated, had become better than it was before. This accidental occurrence having come to the knowledge of General Marey-Mouge, caused the author of this paper to be consulted, and a series of experiments were instituted with various kinds of wine, of inferior as well as medium quality, the result being that a galvanic current, applied to the liquid in the casks, both electrodes consisting of platinum plates, eminently improves even very inferior kinds.

Rendering Rivers Wholesome.—M. Gérardin.—According to this author, the fouling of rivers and water-courses is greatly due to the starch manufactories situate along the same, in consequence of the discharge of water containing up to 7 and 8 per cent of albuminous matter, which soon enters into decay, giving rise to the formation of myriads of lower forms of animal life, which withdraw from the water its dissolved oxygen, and hence cause the destruction of higher organised plants and animals.

Researches on Solar Radiation.—MM. Desains and Branly.—This paper, and the following—

Expansion of Gases—M. Moustier—Are not well suited for useful abstraction.

Molecular Action in Atmospheres of Chlorine, Bromine, and Iodine.—M. Valson.—This memoir contains the results of a series of experiments relating to the capillary action of chlorides, bromides, and iodides in aqueous solution and immersed in gas or vapour of the haloids above mentioned. The results are exhibited in tabulated forms.

New Method for the Preparation of Anhydrous Nitric Acid.—MM. Odet and Vignon.—The authors refer first, at some length, to the now well-known, yet difficult and highly delicate, method of obtaining anhydrous nitric acid, discovered by M. H. St. Claire-Deville. The authors obtain this compound by causing chloride of azotyl to act upon perfectly dry nitrate of silver at from 60° to 70°. Chloride of azotyl is prepared by the action of oxychloride of phosphorus upon nitrate of lead, or, better yet, nitrate of silver. The chloride of azotyl is a slightly yellow-coloured liquid, boiling at 5°, and not frozen at −31°; in contact with water, this substance is decomposed into nitric and hydrochloric acids. The vapour of this fluid is applied for the decomposition of dry nitrate of silver, in a simple apparatus consisting of U-shaped tubes soldered together by means of suitably-bent glass tubes. The chloride of azotyl is prepared simultaneously with the anhydrous nitric acid, which is collected in a tube placed in freezing mixture at −25°.

Preparation of Hydrate of Chloral.—M. Roussin.—The mode of preparation here described is precisely the same as that already well-known, and lately quoted by us from a German paper. Pure hydrate of chloral is a snow-white crystalline substance, not exhibiting any smell at the ordinary temperature of the air; it volatilises slowly, without absorbing much moisture, unless it be placed in a very damp place; fuses at 56°; boils at 145°; is completely soluble in a small quantity of water, and also soluble in alcohol, ether, chloroform, sulphide of carbon, benzine, and fatty substances. Its aqueous solution ought to be neutral to test paper, and ought not to become turbid by a solution of nitrate of silver. When, to this aqueous solution of hydrate of chloral, a few drops of a solution of caustic potassa are added, there is formed chloroform, easily recognised by its peculiar smell.

So-called Inverted Sugar.—M. Dubrunfaut.—There is appended to this paper a short foot-note, from which it appears that there belong to it two papers not printed yet, by M. Maumené, without which this subject is not complete.

Radiation from the Moon.—M. Marié-Davy.—A third memoir on the much-vexed question about the heat given off by our satellite. This memoir is a purely mathematico-physical essay.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 16, 1869.

The president, Dr. A. W. Hofmann, opened the ordinary meeting, from the *procès verbal* of which we learn the following items:—Among the ordinary members elected, we find the name of Prof. Chandler, of New York. Prof. Baumhauer, of Haarlem, promises to send to the Society a regular account of all that is done on chemical territory in the Netherlands. The president exhibits several samples of partly crystallised tin, received from M. Fritsche, of St. Petersburg; this crystallisation is the effect of a continued exposure for three hours of the metal to a temperature below the freezing point of mercury. When the metal is exposed for any length of time to this low temperature, it falls completely to a greyish coloured powder; when this powder is heated to 100°, it becomes whitish-grey coloured. The president exhibits several photograms representing partially-crystallised organ-pipes, which had been inspected and photographed by the late Prof. Erdmann. We may mention here that this crystallisation of the tin whereof organ-pipes are made is by no means an uncommon phenomenon, and one not solely due to cold alone, but, in a great measure, to the vibration these pipes are subject to. The president exhibits a number of samples of wool, dyed green with the so-called iodine green, by M. T. Peters, of Chemnitz, and hands round to the members circulars issued by that dyer, and printed in German, French, and English, on the best method of applying this dye.

Preparation of Hydrate of Chloral.—MM. Müller and Paul.—The chief part of this operation consists in passing a current of dry and pure chlorine gas into pure and absolute alcohol, until the contents of the flask are, after about 70 hours, converted into a white and crystalline mass; when this operation is properly conducted a large quantity of hydrate of chloral is obtained. The authors state that they had found by experiment that the hydrate of chloral is readily sublimed, and may be thus obtained as a dry, snow-white, neutral crystalline powder.

Relation of Mercury-Phenyl to the Aromatic Series.—MM. Dreher and Otto.—Mercury-phenyl is formed by the action of $HgNa_2$ upon C_6H_5Br—

$$2(C_6H_5Br) + HgNa_2 = \left\{ \begin{matrix} C_6H_5 \\ C_6H_5 \end{matrix} \right\} Hg + 2NaBr.$$

The addition of a small quantity of acetic ether greatly promotes the reaction. ClH, IH, and BrH decompose—

$$\left. \begin{matrix} C_6H_5 \\ C_6H_5 \end{matrix} \right\} Hg,$$

according to the following equation:—

$$\left. \begin{matrix} C_6H_5 \\ C_6H_5 \end{matrix} \right\} Hg + 2HCl = HgCl_2 + 2C_6H_5.$$

By the action of chlorine, bromine, and iodine, it is not easy to obtain from mercury-phenyl the respective chlorinated, bromated, and iodated compounds; the reactions and decompositions which take place are represented by the following formulæ:—

$$\left. \begin{matrix} C_6H_5 \\ C_6H_5 \end{matrix} \right\} Hg + 2Cl = \left\{ \begin{matrix} C_6H_5 \\ Cl \end{matrix} \right\} Hg + C_6H_5Cl;$$

when chlorine was made to act upon—

$$\left. \begin{matrix} C_6H_5 \\ Cl \end{matrix} \right\} Hg + 2Cl = C_6H_5Cl + HgCl_2.$$

We refrain from further abstraction of this lengthy paper, which is chiefly composed of a mass of formulæ.

Phosgene.—MM. Emmerling and Lengyel.—This paper is divided into three sections:—(1) *Conversion of carboxysulphide into phosgene.*—Chlorine does not act upon carboxysulphide at the ordinary temperature; but when a dry mixture of both gases is made to pass through a red-hot porcelain tube filled with fragments of broken porcelain, a gaseous mixture of CO, $COCl_2$, SCl_2, and unchanged Cl and COS. In order to recognise the phosgene, and estimate its quantity, the gaseous mixture just alluded to was passed through tubes filled with black sulphuret of antimony, this serving the purpose of separating the phosgene from various admixtures. For the purpose of analysis, the gas was collected in tubes, inside of which a small glass globe was placed, filled with a solution of caustic potassa. After the tubes had been filled with the gas, and sealed, this glass globe was broken (its walls being very thin), by shaking the tube in the fluid contents. After a time, the relative proportions of Cl and S were determined, and in other portions of the gas the CO was separately estimated. (2) *Preparation of phosgene from chloroform.*—This fluid is split up by the action of sulphuric acid and bichromate of potassa, yielding phosgene—

$$2CHCl_3 + 3O = 2 + COCl_2 + H_2OCl_2.$$

Forty parts of strong SO_3, five parts of bichromate, and two parts of chloroform yield, when heated on a water-bath, a phosgene free from oxygen. (3) *Fluid phosgene.*—This was obtained by passing the gas through an U-shaped tube placed in ice. The fluid gas is very volatile, and specifically heavier than water, by which liquid it is decomposed, evolving CO_2.

Under the title of "Correspondence," we meet with a first instalment of a report about the meeting at Inspruck, held in September last. Leaving the excellent and thoroughly German and enthusiastic general account of this meeting, we learn that the chemical section was presided over by Prof. Hlasiwetz, of Vienna, and that eighty-six members regularly attended, while the audience was even rather too large for the large chemistry lecture-room of the University wherein this section met. The following subjects were treated:—

Origin (Entstehung) of Iodoform, and the Applicability of the Formation of Iodoform for Analytical Purposes.—M. Lieben.—Iodoform is, according to this author, the most delicate test for alcohol, provided such substances be absent as might happen to exhibit the same reaction. In ether, even when distilled over sodium, alcohol can be detected by iodoform; and there is no doubt, the author says, that alcohol is formed in all ether which contains or can absorb water. Only those substances which contain CH_3 are capable of forming iodoform.

Modifications of Lactic Acid.—Dr. Wislicenus.—According to the author, there exist three modifications of oxypropionic acid. The lactic acid of fermentation, ethyliden lactic acid, differs from the ethylen lactic acid, and is easily obtained from *β* iod-propionic acid. The lactic acid of muscles differs from the two alluded to, but is not a chemical individual, since it is made up of ethylen lactic acid and a peculiar modification of ethyliden lactic acid.

Phenicin.—Prof. Bolley.—The substance known as phenicin, a brown colouring dye, also known as phenyl brown, is made by adding phenol to a mixture of nitric and sulphuric acids, and by pouring this mixture afterwards into a large bulk of water, when the phenicin is obtained as an amorphous powder. The manufacture of this preparation has given rise already frequently to serious explosions. The author found that the commercial article, as well as the pure article (phenicin), contains binitrophenol, a brown amorphous substance, which is neither a nitro nor a sulpho compound, and produced, it appears, by the action of sulphuric acid upon binitrophenol.

Proteine Compounds—Dr. Schwarzbach.—The author states that the differences found by many experimenters, in the reaction of the potassio-platinum cyanide with the proteine compounds, is due to the fact that, instead of the Gmelin salt, that of Quadrat has been applied.

Preparation of Iodine Substitution-Products.—Prof. Hlasiwetz.—To the substance which is to be iodised, peroxide of mercury is added, and the requisite quantity of iodine is added afterwards. The researches on this subject are not quite complete.

At the meeting of the Russian Chemical Society, held on the 2nd of October (O.S.) last, the following communications were made (communicated by M. von Richter, St. Petersburg):—

Benzimide.—M. Zinin.—The so-called benzimide of Laurent, $C_{23}H_{18}N_2O_2$, which is formed by the action of hydrocyanic acid upon essential oil of bitter almonds, is converted, when heated to from 160° to 180°, into an amide—

$$C_{23}H_{18}O_2N_2+H_2O=C_7H_6O+C_{16}H_{14}O_2N_2,$$

and into a nitrogenous compound, which is the imide of formobenzilic acid.

Bromocamphoric Acid.—M. Wreden.—When dry camphoric acid is heated with bromine to 120°, monobromocamphoric acid anhydride, $C_{10}H_{13}BrO_3$, is obtained. This substance is nearly entirely insoluble in water, alcohol, and ether, at ordinary temperature; it sublimes at about 60°, but is also partly decomposed at that temperature. When this anhydride is boiled with water, a new acid, $C_{10}H_{14}O_4$, is obtained; this acid is readily soluble in water, alcohol, and ether, crystallises from its aqueous solution, sublimes at 110°, and fuses at 201°. The lead and copper salts of this acid are soluble in water; the soda-salt is a very deliquescent substance.

Valerian Aldehyde and Œnanth Aldehyde.—M. Borodin.—When the two substances just named are heated to 240° in sealed tubes, several products of condensation can be directly obtained; the reaction goes on steadily, water is formed, no resinification takes place, and, on opening the tube, no pressure is experienced. The valerian aldehyde yields, when submitted to fractional distillation, two oily fluids, one of which boils at from 195° to 200°, the other at from 180° to 200°. The analysis of these substances proved the first to be the condensation product of two molecules of aldehyde, from which one molecule of water was expelled; the other substance is a polymer of the last-named.

Atomic Weights.—M. Mendelejeff.—This paper contains a new plan of grouping the elements, according to the numerical value of their atomic weights, in the following manner:—Li, 7; Be, 9·4; B, 11; C, 12; N, 14; O, 16; Fe, 19; Na, 23; Mg, 24; Al, 27·4; Si, 28, and so on; but there is a considerable hiatus between Cl, 35, and the next, Ag, 108. The author points out that this grouping of the elements expresses the law according to which the elements can combine with oxygen.

On Xylidine.—M. Tawildarow.—The author prepared xylidine from isoxylol, which was obtained from coal-tar xylol by boiling that substance with dilute nitric acid. The nitroisoxylol thus obtained was reduced by means of tin and hydrochloric acid, and the xylidine purified by means of caustic potassa; the substance thus obtained is a colourless fluid, boiling at 216°; sp. gr. at 18°, 0·985. The oxalate of xylidine crystallises, and is somewhat soluble in water. When xylidine is submitted to distillation, a solid matter is left, which, on being heated to about 240°, yields a substance soluble in alcohol, crystalline, and fusing at 89°; this is a basic substance containing chlorine; its hydrochloric acid compound has the following composition:—$N(C_8H_8Cl)_3.HCl$. 100 parts of xylidine yielded about from two to three parts of this material.

Polytechnisches Journal von Dingler, second number for October, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Blast Furnaces constructed for the Continuous Flowing Off of Slag.—M. Lürmann.—This paper contains the description of an improved blast furnace for ironworks. From a foot-note added to the paper, we learn that the Old Park Iron Company, Shropshire, have adopted the improvements invented by this author, and are highly satisfied with the results.

Chemistry of the Blast Furnace.—M. Schinz.

Manufacture of Steel for the Use of Rifle Guns and Heavy Ordnance at the Works of M. Cockerill, at Seraing.—M. Greiner.—The author states that, at Séraing (near Liège, Belgium), the following three points are rigorously attended to as regards the manufacture of steel for the purpose indicated:—Purity of product; homogeneity thereof; and the exercise of proper control to ensure these requisites. It appears that this branch of manufacture is attended to in a thoroughly scientific manner, the use of the spectroscope, and of chemical analysis and assays, being matters of daily application. The test for carbon is executed in the following manner:—Of two samples of the same kind of steel, 0·2 grm. are placed in beaker-glasses of fully 20 c.c. capacity, and treated with nitric acid of 1·2 sp. gr.; the glasses are kept for four hours on a water-bath, and heated to 80°. The solutions assume a brownish yellow colour, which is compared with the colour which two other solutions of the same quantity of steel, containing a known quantity of carbon (0·61 and 0·63 per cent), assume after the four solutions have been all diluted with the same quantity of

pure water. Suppose the solutions of steel containing known quantities of carbon to be respectively diluted to 252 and 260 c.c., and the solutions of the steel under examination to 142 and 144 c.c., the following calculation will give the required result:—

$$\frac{142 \times 61}{252} = 34{\cdot}33; \quad \frac{144 \times 63}{260} = 34{\cdot}90;$$

therefore the average = 34·615 = 0·346 per cent.

Boiler Incrustation, from Lillschacht, near Pribram.—Dr. Mrazek.—The author obtained for analysis and investigation a quantity of a very white, compact, micro-crystalline substance, which was stated to be the incrustation found in a steam boiler fed with water pumped from a mine. On being analysed, the stone was found to consist, in 100 parts, of:—Lime, 33·60; sulphuric acid, 47·41; magnesia, 12·26; water, 5·52; impurities, 0·79. This result leads to the formula $2(CaO,SO_3)+(MgO,HO)$, constituting, in fact, a mixture of anhydrite and brucite. The analysis of the water proved it to contain, in 10,000 parts—Sulphuric acid, 5·51; lime, 3·40; magnesia, 0·29; with traces only of chloride of sodium and soluble organic matter. The author also obtained a quantity of mud taken from the same boiler; this mud was found to consist, in 100 parts, of—Anhydrite, 14·24; hydrated magnesia, 2·27; lime, 16·49; carbonic acid, 12·96; clay, particles of quartz, oxides of metals, and metallic sulphides, 30·26; particles of wood and water (the former predominating), 23·78. The author states in this paper that if, in the case of boiler explosions, it is possible to obtain some of the incrustation of the exploded boiler, the analysis of that incrustation may lead to the detection of the cause of the explosion; if due to the want of water, and the boiler-plates becoming red-hot, the exact estimation of the water chemically combined with the incrustation is sufficient, since, if the boiler had been red-hot, the whole of the water of combination will have been expelled.

Apparatus for the Safe Keeping and Transport of Petroleum, Benzol, &c.—Dr. Tech.

Application of Iridium for Staining Glass and China.—M. Frick.—It appears that pure oxide of iridium yields, upon glass and china, a black-coloured stain of so intense and deep a tone of shade that the other substances in use for that purpose are, compared with this colour, of a brownish hue. The pure oxide of iridium is obtained, especially as a bye-product, in the purification of American platinum ores, and may be obtained from M. Röszler, at Frankfort-on-the-Maine.

Moniteur Scientifique, November 15, 1869.

Artificial Alizarine.—M. Bolley.—There are at present already three artificial products which come into competition with madder and its various preparations, viz.:—(1) It appears that MM. Græbe and Liebermann have stated, at the congress of German *savants* lately held at Insprück, that they can dispense with the use of acetic acid and bromine, and will be enabled shortly to bring into the trade a superior product, made by a method different from that described in their patent, and that this new product will be manufactured at Manheim by a celebrated firm of aniline colour makers. (2) Artificial purpurine and alizarine, made by MM. Broenner and Gutzkow, according to their patent, by the action of protronitrate of mercury upon anthrachinon; this process is carried on at Frankfort-on-the-Maine. (3) Artificial alizarine (alizapurine, according to M. Alfraise), prepared, by a process as yet kept secret, by MM. Meister and Lucius, at Hoechst, near the same city just named. The author of this paper just named states that he received from M. Riese, the head chemist to the firm just alluded to, at Hoechst, a quantity of 500 grms. of the paste (artificial alizarine) in question, with the request to assay it and report thereon. This substance exhibits a greenish brown-coloured, rather fluid paste, containing about 6 per cent of dry solid matter; when this dry substance is cautiously submitted to an elevated temperature, a brick-red coloured sublimate is obtained in needle-shaped crystals, a bulky carbonaceous residue is left, and, on igniting this, the ash is found to contain a large proportion of oxide of iron. The sublimate dissolves in caustic soda, exhibiting a very deep blue-violet colour; this solution yields, by the addition of chloride of barium, a bluish violet-coloured precipitate, which resembles, in a high degree, the precipitate obtained under similar conditions from the alizarine of madder. The ammoniacal solution of the sublimate, and the percipitate formed therein by the baryta-salt, also, resemble the reactions obtained from native alizarine from madder under the same conditions. The sublimate referred to yields, on being boiled with a solution of alum, a partial solution in alum, but the dissolved material precipitates on cooling, and the fluid then exhibits only a rose-red colouration; it would accordingly appear that the sublimate consists mainly of alizarine, mixed with very little purpurine. The results of elementary organic analysis of this substance are quoted as follows, three analyses having been made, and the carbon and hydrogen only put down percentically:—C, 69·23; H, 3·38; C, 66·04; H, 3·28; C, 66·46; H, 3·39. The composition of purpurine, according to M. Schutzenberger, $C_{20}H_{12}O_7$, requires percentically—C, 65·93; H, 3·29. Alizarine dried at 100° is, according to Dr. Schunck, percentically—C, 69·13; H, 4·03; and, according to MM. Bolley and Rose—C, 69·54; H, 3·75. The author infers, from these facts, that the sublimate holds a composition intermediate between alizarine and purpurine; that the first portions of the sublimate above referred to contain more, or, rather, approach more to, alizarine, and the latter portions more to purpurine. On comparing the tinctorial properties of this sublimate with those of alizarine obtained from madder, the following was observed:—(1) In the dry state, the artificial alizarine in question is less suitable as a dye than when it is in paste; (2) its tinctorial power, when dry, is at least equal to one-and-a-half times the same weight of raw (green) alizarine from madder, as prepared by M. Kopp's process; (3) the artificial alizarine dyes mordanted cloth rapidly, but soils the white grounds more than green alizarine; (4) the red is very brilliant and pure after cleansing (*avivage*); (5) the violet assumes, after cleansing, a greyish hue, and the puce and black are excellent. All these colours are fast, and in no way inferior to those obtained from madder. According to the author, the experiments instituted by MM. Alfraise and C. Kœchlin, with the view to prove that the preparation alluded to, and produced by MM. Meister and Co., is neither alizarine nor purpurine—are not made with sufficient care, and with a too impure material (the paste only) to deserve the required confidence. As regards the tinctorial power of the paste, also, this appears to have been overrated by M. C. Kœchlin.

Dyeing with so-called Iodine-Green Paste on Wool.—M. Kalle.—This author, wholesale manufacturer of artificial dyes at Biebrich (Nassau, Prussia), states that, having read the communication on the process described by M. Peters in the number of the 1st of November last of this periodical, he feels obliged to point out the following defects in that communication:—(1) When the workman does not happen to use great skill and precaution, the green does not completely dissolve in acidulated water; hence there is a loss of colouring matter. (2) When the colouring matter does not dissolve completely, filtration has to be resorted to, which it is best to avoid. The author next gives the following directions, referring, however, to the use of a pure paste only:—The paste is mixed up with one or two parts of cold water (the quantity of water depends upon the state of concentration of the paste; if the latter happens to be very fluid, or, what amounts to the same, poor in colouring matter, the addition of water is unnecessary), from six to eight parts of alcohol are added, and the mixture well stirred up. *Impregnation tincture.*—The dye-bath ought to contain, for 1 kilo. of green in pasty state (price 50 francs, £2), 1 kilo. of silicate

of soda of 30 per cent strength, and is brought to the boiling point. When this has been reached, the alcoholic solution of the green above alluded to is poured into the bath, and the wool thoroughly worked through it, without more heating, until the desired shade has been obtained; the wool is next drained, wrung out, and washed in cold water, and then only brought into the developing bath composed as described by M. Peters. The author adds that the developing bath becomes gradually saturated with dye-stuff, and then unfit for use for clear shades of colour; when this point is reached, the liquid is filtered, neutralised with ammonia, a fresh quantity of silicate of soda is added, and the liquid so obtained used as a dye-bath.

Preparation of Victoria Yellow (Binitronaphthol).—MM. Darmstädter and Wichelhaus.—One part of napththaline is mixed with two parts of concentrated sulphuric acid, and heated on a water-bath until the solution is complete; the sulpho-naphthalic acid so obtained is saturated with soda, and the solution is evaporated to dryness. The sulphonaphthalate of soda is next fused with caustic soda, and the mass resulting from this operation is dissolved in water and supersaturated with HCl, whereby naphthol, or hydrate of naphthyle, is separated. This substance is next boiled with a mixture of sulphuric and nitric acids, yielding binitronaphthol, the yellow colouring matter; this substance is chemically different from, but, after all, isomeric with, the so-called Martius yellow, or binitronaphthylic acid. The formula, $C_{20}H_6.N_2O_8.O_2$. answers for both equally well; industrially speaking, both substances approach each other to such a degree that they may be considered identical; both are best used in the state of ammoniacal salt, this being the most readily soluble salt for each. These materials are employed at Paris for the adulteration of gamboge, and very largely used for the colouration of artificial flowers, leather gloves, &c.

Manufacture of Carbonic Acid on the Large Scale.—M. Dietz.—After reviewing several processes in use for this purpose, the author describes, at great length, a process in actual use at Kama, near Tschistopol, Russia. The gist of the description is that the gas given off by a lime-kiln heated with wood is used as a source of carbonic acid for converting carbonate of soda into bicarbonate. During twenty-four hours, 900 cubic metres of carbonic acid gas are consumed, and the combustion of the wood used for heating the kiln is so regulated as to yield a portion of that gas along with that obtained from the limestone; wood, however, in that locality, is almost a waste material, being extremely abundantly found.

Grotto of the Dead.—We notice the title of this paper, which contains a very interesting description of the Baumo des Morts, near Durfort, Departement Du Gard, France. For the study of the earliest age of man's appearance on the globe, this is a valuable contribution.

Journal für Gasbeleuchtung, Nos. 9 and 10, 1869.

These numbers contain the following original papers relating to chemistry and allied sciences:—

What is Good Gas?—Dr. Schilling.—In a lengthy and exhaustive paper, the author reviews this question on all sides, and comes to the following conclusions. A good and suitable gas for artificial illumination ought to possess the following qualities:—(1) The gas ought to possess a normal illuminating power. The exact determination of the value of the normal illuminating power can only be obtained when the gas made from various qualities of coal, and manufactured according to rational principles, is compared, under exactly identical conditions, with the normal standard candle. Any gas which, by a combustion of 5 cubic feet per hour, exhibits a light equal to fifteen spermaceti candles, may be considered a gas of good illuminating power. (2) The gas should be absolutely free from sulphuretted hydrogen. (3) The pressure of the gas at the works and in the leading mains should as a minimum, amount to from 0·8 to 1·0 of the water-pressure gauge.

Researches on the Coals from Saarbrueck.—M. Gasch.—A most valuable addition to the chemistry and technology of coals, containing the results of elementary organic analysis, the quantity and quality of gas and coke yielded by each kind of coal, the transportability of the coal (*i.e.*, the resistance against breakage and falling into smalls and dust), carefully determined. The value of coal and coke as fuel, and the exact determination of the illuminating power and durability of the gas, when manufactured on the large scale, according to the best method, including pyrometrical measurement of heat applied to the retorts.

Gas Meter Testing Regulations for the North German Confederation.

Hydrogen and Carbonic Oxide Gas.—M. Schinz.—The author proposes the use of a mixture of equal quantities, by bulk, of these gases, instead of hydrogen only, for illuminating purposes, by means of incandescent platinum. Experiments made prove that the illuminating power of this mixture is, for equal consumption, equal to 1·242, coal gas of good quality being 1·0.

Photometrical Studies.—Dr. Rüdorff.

Contribution to the Purifying Question.—M. Cox.—Under this title, the author discusses and elucidates, by a series of experiments, the action of sulphuretted hydrogen and hydrated peroxide of iron.

Comparison of Various Kinds of Gas in reference to its Cost of Production and Illuminating Power.—M. Sautter.

Zeitschrift für Chemie von Beilstein, No. 21, 1869.

This number contains the following original papers:—

Formation of Glycolamidic Acids.—M. Ziegler.—When a concentrated solution of glycocol and monochloro-acetic acid is boiled with chlorinated diglycolamidic acid, the result is triglycolamidic acid; but since, when glycolic acid and ammonia are boiled with the same substances, neither glycol, nor di- and triglycolamidic acid are formed, the author thinks there is no doubt that, when these acids are prepared from ammonia and monochloro-acetic acid, the one is formed after the other, because an atom of hydrogen bound to one of nitrogen combines with an atom of chlorine of the monochloro-acetic acid.

New Mode of the Formation of *a* Triphenyl-Guanidine.—MM. Merz and Weith.—Equal molecular quantities of aniline, carbanilide, and one third molecule of trichloride of phosphorus, yield, when mixed, a solid mass, which, while fusing at 140°, effervesces strongly, and, giving off hydrochloric acid, is converted into a basic substance and phosphorous acid (when carbanilide and aniline alone are heated together to about 190°, no reaction takes place). The basic substance just alluded to is, after having been purified, found to be triphenyl-guanidine, fusing at 143°; its platinum compound contains 19·85 to 20·01 per cent metal. This reaction is represented by the following formula:—

$$\left.\begin{array}{l} N\langle^{C_6H_5}_{H} \\ 3CO \\ N\langle^{H}_{C_6H_5} \end{array}\right\} + 3C_6H_5.NH_2PCl_3 = \left\{\begin{array}{l} N\langle^{C_6H_5}_{H} \\ 3C{=}NC_6H_5 \\ N\langle^{H}_{C_6H_5} \end{array}\right. + 3HCl + H_3PO_3.$$

100 parts of carbanilide yield 135·3 parts of this basic substance.

Decomposition of Dichlorobromo-Hydrine by Hydrate of Baryta.—M. Claus.—This paper may be briefly summarised in the following words:—It appears that a dispute has arisen between the author and some other scientific chemists, on the subject of the action of baryta and dichlorobromo-hydrine. Among the products of decomposition,

propyl-phycitic acid was found by some of the parties; the author now says that that acid is only glycerinic acid, and quadriacid-propyl-phycitic alcohol, formerly supposed by the author to exist, has not had its existence proved with sufficient accuracy.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., No. 2, 1869.

The only paper relating to chemistry in this number is:—

Absorption of Hydrogenium by Iron Galvanically Obtained.—M. Jacobi.—Iron, precipitated galvanically, is described by the author as a silver-grey coloured, velvety-looking, very finely-grained mass, of 7·675 sp.gr. at 15°; this metal is so hard that it scratches glass, but is, also, very brittle. When this metal was very carefully ignited in a covered platinum crucible, its colour became deeper, its hardness and brittleness were lost, and its sp. gr. had increased to 7·811, which is higher than that of wrought-iron. The fact of this increase of specific gravity led the author to conclude that the iron might contain gas absorbed in its substance. A quantity of 9·730 grms. were treated in a Sprengel's aspirator, with the result that, aided by an increased temperature, which was carried to dull-red heat, 17·76 volumes of gas, chiefly composed of hydrogen, were obtained from the quantity of iron submitted to experiment.

Les Mondes, November 25, 1869.

This number contains the following original matter:—

Speech at the Opening Meeting of the German Naturalists and Physicists, at Insprueck.—Dr. Helmholtz.—From this very eloquent and very able speech, we quote the few following phrases:—The discovery of the common tie existing between and uniting together all the phenomena of nature, is the final aim of all science, and towards the reaching of that aim the efforts of all workers of science must be directed; only the knowledge of the laws which rule and govern the material world will enable man to make it obey his will. The speaker, in his discourse, referred briefly to astronomy, as the science of the laws of gravitation; to chemistry, as the science of inalterability of matter and its varied combinations; and next spoke about conservation of forces. At the conclusion, the speaker stated that Germany is, therefore, in advance of all the rest of the scientific world; because, out of that country, and more especially in France and England, scientific men had to heed social, and, far more yet, religious prejudices, and were thereby prevented free utterance of thought, since it would damage their social influence. On the whole, the speech is thoroughly Teutonic in the highest sense of the word, and the terseness, as well as the eloquence of the printed report, cannot fail to imbue the reader with respect for the very sound and able manner wherewith the eminent speaker discussed, extempore, abstruse scientific truths. Under the presidency of Prof. Hlasiwetz, of Vienna, the following papers were read in the chemical section: (1) On "Iodoform," M. Lieben; (2) "On Lactic Acid," M. Wislicenus; (3) "On Phenylic Brown," M. Rolly; (4) "On Proteine Substances," M. Schwartzenbach; (5) "On the Sulphurets of Nitrogen," M. Claust; (6) "On the Hydruret of Palladium," M. Bœttger; (7) "On Anthracen," M. Petersen; (8) "On Hydrargyrodinaphthyl and Phenyl," M. Otto.

Presence of Salt in Sea Air.—Dr. Gillebert d'Hercourt.—From a series of observations made at Monaco, on the shores of the Mediterranean, the author concludes that there is always on the sea shores an atmosphere impregnated with saline particles; this layer of air has, at the above-named place, some 500 metres' horizontal, and some 60 metres' vertical extent. This impregnation of salt is due to what the author terms "pulverisation" of the sea-water by the breaking-up of the surf, and is not directly influenced either by barometric pressure, hygrometric state of the atmosphere, or its temperature. This hydro-mineral dust (*poussière*), as it is called by the author, is, unless there happen to exist near the coast physical obstacles, in the shape of high mountains, carried far away inland, and is not to be confounded with what is of more coarse nature, and termed "spray," which is only quite local, and produced when a gale of wind blows. The author states that, even on calm days in winter, the atmosphere near Monaco is at least up to a height of 70 metres, and some few miles inland impregnated with this hydro-mineral dust. There is no tide (rise or fall of water) perceptible in the sea alluded to.

Journal de Pharmacie et de Chimie, November, 1869.

This number contains the following original papers:

Researches on the Bleaching of Tissues.—M. Kolb.—The second portion of a lengthy paper on this subject.

On Carlinate of Potassa and Carlinic Acid.—M. Lefranc.—Carlinate of potassa is a white-coloured salt, crystallising in needle-shaped crystals, and soluble in water and in alcohol of 60 per cent. When it is carefully heated, it fuses in its water of crystallisation; and when the heat is increased, it burns off, leaving carbonate of potassa. The aqueous solution of this salt gives no precipitate with chloride of barium, and with neutral or basic acetate of lead; with nitrate of silver it yields a white precipitate, insoluble in acetic, but soluble in nitric acid. The carlinic acid is separated from any concentrated aqueous solution of a carlinate, by means of a slight excess of tartaric acid. Alcohol is added in excess, the fluid filtered, and next evaporated upon a water-bath to dryness, and taken up with ether, from which the acid separates, on evaporation, in a crystalline shape. The acid is very soluble in water, alcohol, and ether, and is naturally met with in the roots of the *Carlina gummifera*, L.

Best Method of Preparation of Emetics.—M. Fleury.—This is a short memoir, not, as would be inferred from its title, on the preparation of the potassio-tartrate of antimony, but on the preparation of a series of double salts of tartaric acid and bismuth with lime, baryta, magnesia, protoxide of manganese, oxides of copper and zinc; of tartaric acid with chromium, lime, and baryta, and similar salts of iron. The author promises to give, in a future paper, the mode of preparation and analysis of all these salts.

On Chloral.—M. Poggiale.—The contents of this paper are superseded by the paper on this subject abstracted by us from the *Berichte der Deutschen Chemischen Gesellschaft zu Berlin*, No. 16, 1869.

Camphor Water.—M. Jeannel.—The question of the solubility of camphor in water has been often discussed. According to the author, an alcoholic solution of camphor was made containing 0·375 grm. per c.c.; and a litre of water at 15° does not dissolve more than 0·75 grm. of camphor from this solution after twenty-four hours' contact and frequent shaking. The author states that alcohol does not increase perceptibly the solubility of camphor in water; alcohol at 20° only dissolves 2·437 grms. of camphor, and at 35°, 6 grms of that substance per litre of alcohol.

Explosion Caused by the Incautious Making-Up of a Medicinal Prescription.—M. Vigla.—The following prescription was handed to a pharmaceutist:—Chlorate of potassa, 8; hypophosphite of soda, 4; simple syrup, 62; water, 125. The operator put the dry salts in a mortar, and commenced rubbing them vigorously, when a most violent explosion ensued, whereby the mortar was smashed to atoms and the operator seriously wounded. The proper course would have been to dissolve each of the salts separately in water.

Moniteur Scientifique, December 1, 1869.

This number contains the following original papers:—

The Physical Phenomena Manifested by Living Organised Beings.—M. Gavarret.—In a lengthy paper

the author discusses and explains the physico-chemical phenomena of life, as far as this is possible. The paper is recommended to the attention of all who study biology.

Artificial Alizarine made by MM. Meister, Lucius, and Co., at Hoechst.—M. Kopp.—Since this subject is, in a scientific as well as industrial point of view, of great importance, we abstract this paper, notwithstanding the same subject has been lately treated by Dr. Bolley. M. Kopp received, from the well-known chemist, M. C. Kœchlin, a quantity of 250 grms. of this artificial alizarine, in the shape of a paste, containing only 7 per cent of dry substance, ash inclusive. The author states that this substance produces a most brilliant and very fast Turkey red. The artificial alizarine was dissolved in a weak aqueous solution of carbonate of soda, filtered and precipitated by means of pure HCl, and the precipitate collected on a filter until the filtrate was quite neutral; the material, thus purified, was used for the purpose of comparison with pure alizarine as obtained from madder. Equal quantities of each of these two substances were dissolved in a weak solution of caustic soda, and with these solutions the following tests were made:—Artificial alizarine $+Na_2O+Cl_2Ba$: violet-blue precipitate, supernatant liquid somewhat faintly rose-coloured; natural alizarine, and the same reagents; also a violet-blue precipitate, supernatant liquid faintly yellowish-rose coloured. Artificial alizarine $+Na_2O+ClCa$: a violet precipitate, supernatant liquid wine-red coloured; natural alizarine, and ditto reagents, ditto precipitate, supernatant liquid wine-red coloured, but less deeply. Other reactions were instituted, all leading to the manifest conclusion that there is no essential difference between this artificial alizarine and natural alizarine. The author records, at length, his experiments with this artificial alizarine, and the action of nitric acid upon this substance, the result of which is that the substance in question gives rise, not only to the formation of phthalic acid, but also nitro-picric acid. When this dried artificial alizarine is treated, at between 150° and 170°, with boiling petroleum oil, a large proportion of the colouring matter is dissolved, and, on cooling, deposited from the oil in needle-shaped crystals. Dr. Quesneville, the editor of the periodical above quoted, adds to M. Kopp's paper a letter received by him, the main purport of which is that MM. Græbe and Liebermann, at Berlin, have been having, with the firm of Meister, Lucius and Co., a lengthy correspondence, and have been treating with them for the carrying out of their invention on the large scale. These negotiations do not appear to have been successful; and the head of the firm at Manheim, which now carries on the working of the patent of MM. Græbe and Liebermann, happening to be at Berlin while the negotiations with the firm at Hoechst were still pending, accepted the terms made by MM. Græbe and Liebermann; and there is reason to suppose—and this supposition is strongly confirmed by the researches made by MM. Kœchlin, Bolley, Alfraise, and Kopp, on the artificial alizarine made at Hoechst—that that substance is, in reality, obtained by the process discovered by MM. Græbe and Liebermann, and not, as it is made to appear, by a peculiar process the invention of the manufacturers.

On Ipecacuanha and Emetine.—M. Lefort.

Use of Alkaline Sulphurets for the Purpose of Bleaching Fibres and Tissues of Vegetable Origin.—M. Tessié du Motay.—The chief point in this paper is that the author supposes that the alternate action of reducing and oxidising substances accelerates the bleaching of hemp, flax, and cotton, and the tissues made thereof, and that the strength of the fibre is less impaired by this process. The substances applied as reducing materials are the sulphides of barium or calcium mixed with some sulphide of sodium, and the oxidising substance is chlorine water.

Revue Hebdomadaire de Chimie, November 25, 1869.

New Kind of Gas Furnace.—MM. Bergé and Delheid.—This furnace, or, better, blast-lamp, is a modification of the Bunsen burners in general use, and differs from the latter in the following particulars:—(1) By the mode of the admission of the air, which is made to come in below the gas, and not on the same level therewith, or above it, as in the ordinary Bunsen burners; (2) by the admission of a larger quantity of air, by making it pass through the entire area of the tube; (3) by the addition of an outer cylinder, placed to prevent the heating of the tube from which the flame issues, by making a current of air pass between the two. From the report of the makers of this apparatus, it appears to be of immense service, especially for fusions of mineral substances requiring a high temperature and long-continued heat.

Mode of Treatment of the Fermented Molasses' Juice in order to Extract therefrom Crude Potassa Salts.—MM. Crespel and Bocquet.—The authors add, to the residue of the distillation of the previously-fermented molasses as obtained from beet-root sugar making, a sufficient quantity of carbonate of baryta to convert the sulphuric acid present therein as sulphates into carbonates, and thus to obtain more carbonate of potassa in the saline residue after calcination. The sulphate of baryta formed hereby is re-converted into carbonate by well-known methods.

Formation of Ellagic Acid by means of Gallic Acid.—M. Lowe.—When an aqueous solution of two equivalents of gallic acid and one equivalent of arsenious acid is boiled for several hours, a crystalline precipitate is formed, which is ellagic acid. When it is desired to prepare the latter in quantity, the mixture of the two substances alluded to is made in the proportions mentioned, and, after having been boiled and evaporated to dryness at 120°, is exhausted with alcohol at 90 per cent, wherein the ellagic acid only is soluble.

December 2, 1869.

Salts of Uranium and Cobalt.—M. Selhorst states that, notwithstanding some assertions made to the contrary, the solutions of salts of uranium and cobalt are not fluorescent in Geissler's tubes.

Chemical Method of Purifying Tissues made of Animal Fibres.—MM. Bang and Monestier.—The authors state that woollen and silken tissues are purified from vegetable fibres accidentally mixed up therewith, by steeping the tissues in a mixture of equal parts of water and strong sulphuric acid at 90° temperature, followed immediately by a very efficient washing in plenty of cold water, best a running stream.

Bleaching Wool and Silk.—M. Frézon.—The author proposes to substitute, for the ordinary sulphuring, as it is termed, the use of a mixture of equal parts, by weight, of oxalic acid and common salt, of each 2 kilos., upon 1000 litres of water. The tissues, or yarn, to be bleached is left in this bath for one hour, and next washed in plenty of fresh water.

Boiling-Point of some Concentrated Solutions of Salts.—M. Legrand.—Upon 100 parts of water, each of the following substances, in the quantities quoted, yields a solution, the boiling-point of which is expressed in °C.:—61·5 of chlorate of potassa, 104·2°; 60·1 of chloride of barium, 104·4°; 48·5 of carbonate of soda, 104·63°; 112·6 of phosphate of soda, 106·6°; 59·4 of chloride of potassium, 108·3°; 41·2 of chloride of sodium, 108·4°; 88·9 of chloride of ammonium, 114·2°; 296·2 of neutral tartrate of potassa, 114·67°; 335·1 of nitrate of potassa, 115·9°; 117·5 of chloride of strontium, 117·85°; 224·8 of nitrate of soda, 121·0°; 209·0 of acetate of soda, 124·37°; 205·0 of carbonate of potassa, 135°; 362·2 of nitrate of lime, 151°; 798·2 of acetate of potassa, 169°; 325 of chloride of calcium, 179·5°; an unlimited quantity of nitrate of ammonia, 180°. All the salts to be applied in dry state.

The Journal of the Franklin Institute, October, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Various Processes for Preserving Timber.—Dr. Ott.—From this paper, the second portion of a lengthy memoir on this subject, we learn that the opinion that carbolic acid, and substances containing it, or supposed to contain it, are effectual in preserving timber, is erroneous. The real preservative action of the tar-oils are due, according to this author, to a greenish fluorescent oil that comes over at the last stage of the distillation. Direct trials with pyren and para-naphthaline do not yield successful results. The question whether tar (coal-tar) does contain a sufficient quantity of the fluorescent greenish oil just alluded to, so as to justify the use of coal-tar for preservative purposes, is answered in the negative. The decay of timber, or peculiar transformation which makes it unfit for practical purposes, seems to be, in most instances, produced by the attack of fungi and lichens. The mouldering of wood is distinct from decay, it being merely a chemical process caused by the action of water with small access of air. None of the processes invented to preserve timber by chemicals are perfect; the most simple and practical method is the old, but, unfortunately, far too slow, plan of properly subjecting timber to the action of air and water, as practised in ship-building yards.

This number is almost entirely filled with various valuable papers on the late solar eclipse.

American Journal of Pharmacy, November, 1869.

This number contains the following matter more particularly relating to chemistry:—

Prevention of the Bumping of Liquids.—M. Schumann.—After briefly referring to the several suggestions made for this purpose, and, among these, in particular to Dr. H. Müller's process, the author says—In distilling acids and other liquids, I proceed in the following manner:—The end of an ordinary glass pipe, of about ½ of an inch opening, is shut at one end, and this end bent into a little hook; the glass pipe is then cut exactly so long as to reach from the bottom of a glass retort to within ½ or 1 inch of the stopper of the tubulus. By means of the hook and a piece of twine, or a little hook of thin wire, this glass pipe is placed into the retort, the open end at the bottom, and the retort can be filled, or the retort is filled first and the glass pipe entered afterwards. If the liquid is warmed, the air in the glass tube is expanded, and constantly bubbles out at the open end; and if the boiling-point is reached, vapours of the tension of the atmosphere are formed at the spot where the glass pipe stands on the bottom of the retort, and the boiling continues regularly and quietly.

New Properties and Uses of Naphthaline.—Dr. Ott.—After relating the manufacture of this substance, the author says—Pure naphthaline, as now met in the trade, is similar to alabaster, cracks easily in the warm hands, and becomes negatively electric on being rubbed with silk. Its sp. gr. at 66° F. is 1·15173, melts at 174° F., and boils at 452° F. Molten naphthaline absorbs a large quantity of air, which is given off again on cooling; according to M. Vohl, this gas is pure oxygen. Molten naphthaline dissolves indigo with great facility, forming a dark blue violet liquid, from which the indigo separates on cooling, forming fine shining needles like copper. The amorphous sulphides of arsenic, tin, and antimony are also readily dissolved, and likewise phosphorus, sulphur, iodine, the iodide and chloride of mercury, arsenious, succinic, benzoic, and oxalic acids. Naphthaline can be converted into naphthalic, or phthalic acid, and this latter into benzoic acid, and that, in its turn, into benzol. Naphthaline, $C_{20}H_8$; phthalic acid, $C_{16}H_4O_8$; benzoic acid, $C_{14}H_6O_2$; benzol, $C_{12}H_6$. For the conversion of naphthaline into phthalic acid, 12 parts of pure naphthaline are dissolved in 90 parts of concentrated sulphuric acid, and, next, 80 parts of best finely-powdered peroxide of manganese are added. After the reaction is complete, the product is boiled in five times its own bulk of water, until no more carbonic acid gas is given off; the fluid is next diluted with water, filtered, and evaporated. The conversion of the phthalic acid into benzoate of lime, at a temperature of from 625 to 660° F., is performed in vacuum, but requires considerable skill and practice; an excess of lime is required.

Comptes Rendus des Séances de l'Académie des Sciences, December 6, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Influence which Water Exercises upon the Double Decomposition of Saline Matter and upon the Thermic Phenomena by which these Decompositions are Accompanied.—M. Marignac.—This paper records the results of a series of experiments made with the view to ascertain, by the measurement of the thermal phenomena, what really takes place in double decomposition when rather dilute saline solutions are operated upon. When water is added to any solution of a salt or acid, a variation of temperature always takes place, which may be an absorption of heat or a disengagement thereof, but which does not exceed 0·2° for solutions of 1-10th, and becomes less for more dilute solutions. This rule is not, however, absolute, because the thermic effect caused by the dilution of sulphuric acid becomes greater with more diluted solutions. The figures 92, 135, 185, 255, express the caloric per equivalent (49), according to the state of the dilution, being 1-10th, 1-20th, 1-40th, 1-80th. The mixing of solutions of two salts which cannot decompose each other gives rise to thermic effects which are less marked. We regret that space forbids us now to enter into more details of this subject.

Reply to Remarks made by M. V. Regnault concerning Thermometers, and the Measurement of Temperature with these Instruments.—M. Bosscha.—The author answers the objections made by M. Regnault, and states that the paper of the latter does not teach anything certain on the indications of the thermometer between 0° and 100°; that M. Regnault considers that differences of 0·2° to 0·3° are insignificant quantities, which are too difficult to estimate, and may be neglected. The greater part of this paper is devoted to the question of the influence of peculiar kinds of glass on thermometers constructed with them.

Remarks on some Matters Relating to Spectrum Analysis.—M. Lecoq de Boisbaudran.—The author, in this paper, gives a preliminary account of the spectrum of the aureola emitted by the positive pole, that of the blue light of the negative pole, and that of the tail of fire (*trait de feu*). It being the author's intention to publish a memoir on this subject, we confine our abstract to this enumeration of contents.

Illumination of Transparent Substances.—M. Soret.—This paper contains, chiefly, observations on the labours made on this subject by M. Lallern, and there is attached to it a short note by M. Chevreul, who points out, in reference to observations made by the author as to the great difficulty of obtaining perfectly pure water, and the effect of that fluid upon glass vessels, that, as far back as the year 1811, he (M. Chevreul) found ammonia in all waters, however carefully distilled, and, besides this, he found it invariably to contain alkaline silicates, derived from its action upon glass, which is, even at comparatively low temperatures, acted upon by water. The eminent *savant* states that the bottles in use in his laboratory are made of green glass, which does not contain lead, and is better fit to resist the action of water, as well as of chemicals.

Researches on the Action of Contact (Catalytic Force of Berzelius).—M. Dubrunfaut.

Normal Quantity of Sugar Contained in Wine.—M. Petit.—The author states that he has tested several samples of Bordeaux, Burgundy, Cahors wines, and wines produced in the Departments of du Cher, de la Loire, and de l'Indre, and found that the quantity of sugar contained therein varies from 5 to 0·5 grms. to the litre of wine. No

sugar could be detected in old wines. The quantitative estimation of sugar in these fluids is done by the author in the previously decolourised wines (by means of filtration through animal charcoal), and treating the filtered liquid with the well-known Fehling reagent. The sugar may be obtained in the separate state by saturating the wine with lime-water, evaporating to dryness, and treating the residue with alcohol at 40° (95 per cent). The sugar is left, on evaporation of the alcohol, and may be used for controlling the Fehling test by means of fermentation.

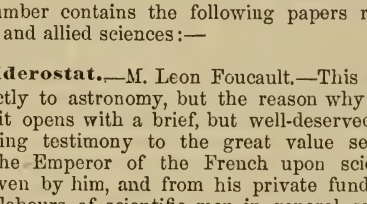
Chemical Composition of Fossil-Bones.—M. Scheurer-Kestner.—This very interesting and lengthy paper contains a series of results of analysis obtained by the investigation of fossil-bones of mammoth horses, and of bones of human skeletons belonging to the earlier centuries of our era. The author points out and proves that chemical analysis can decide the question of the respective ages of bones of various animals found mixed up together, and thus prove that these beings have not necessarily been contemporaneous with each other. This paper contains a large number of tabulated results of analysis made with the special view to careful estimation of the organic matter contained in the various bones. As instances, we quote the following, expressed in 100 parts:—Parietal human bone—Ordinary osseine, 3·1; osseine, soluble in dilute HCl, 12·3; water, 6·0; silica, 3·5; bone-earth (phosphate and carbonate of lime), 74·4. Fossil-horse—Ordinary osseine, 3·9; soluble osseine, 9·3; water, 6·8; silica, 0·3; bone-earth, 79·3. Mammoth bones—Ordinary osseine, 2·8; soluble osseine, 8·9; water, 5·7; silica, 12·4; bone-earth, 70·1. These bones were found in the Lehm, near Colmar, Bas-Rhin.

December 13, 1869.

This number contains the following papers relating to chemistry and allied sciences:—

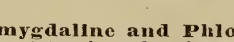
The Siderostat.—M. Leon Foucault.—This paper belongs strictly to astronomy, but the reason why we notice it is that it opens with a brief, but well-deserved observation, bearing testimony to the great value set by His Majesty the Emperor of the French upon science, and the aid given by him, and from his private funds, to promote the labours of scientific men in general, and in this special case to cause, at his expense, the continuation and publishing of the works of the deceased *savant* named at the head of this paragraph.

Constitution of Amygdaline and Phloridzine. M. H. Schiff.—The author states that when he published a paper on arbutine, he briefly alluded to the subject of this paper, and gives, for the two substances just named, the following formulæ:—

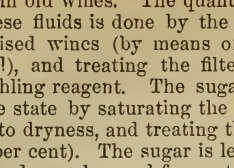


Amygdaline. Phloridzine.

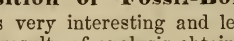
When amygdaline is treated with boiling anhydrous acetic acid, there is formed an heptacetylous amygdaline—



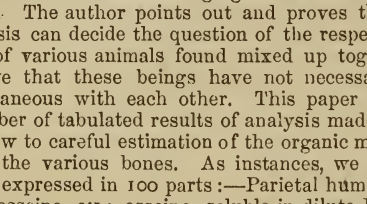
It is a solid substance, crystallising in needle-shaped crystals; amygdaline does not contain benzoyl, (C_7H_5O). When amygdaline is treated with aniline, which only acts upon the former at a temperature of between 160° and 180°, there is formed amygdaline-anilide—



This anilide is not crystallisable, and is very unstable, since, by the addition of boiling water, it is decomposed into aniline and amygdaline. Amygdaline does not contain any ammonia, and is not an amide of amygdalic acid, the formula of which is—



When anhydrous acetic acid acts upon phloridzine, three acetylated derivatives are obtained; one of these is crystalline, the two others are amorphous; they are represented by the following formulæ:—



Acetyl-phloridzine. Triacetyl-phloridzine. Pentacetyl-phloridzine.

Facts respecting so-called Interverted Sugar.—M. Maumené.—This paper is a review of the labours of M. Dubrunfaut on this subject.

Spectrum Analysis, as Applied to the Detection of Gaseous Substances, either when Single or Mixed.—M. Dubrunfaut.—This paper is not suited for useful abstraction; we may give it in full at a future period.

Analysis of the Morallon Kind of Emerald from the Muso Mines (New Granada).—M. Boussingault.—In the carburated schist of Itoco two kinds of emeralds are met with, designated by the appellation *canutillos*, crystallised emeralds, always of great value, and *morallones*, amorphous and often fissured stones; of the latter kind the author has had a kilo. to experiment with akin to the first-named species; the colour of the latter varies from very deep green to very pale green, but the morallones are hardly transparent at all. Their sp. gr. is 2·64. On being submitted to strong heat, the loss per cent is 1·92. The analysis of this mineral has, at various periods, given rise, the author states, to some controversy. The older chemists considered that the colour was solely due to metallic oxides. But M. Loewy obtained a large proportion of carbonic acid when he ignited this mineral (the canutillo as well as morallon kind) in a current of oxygen; and he therefore concluded that the colour was due to organic matter. But M. Woehler and other German chemists saw that emeralds kept for an hour at the melting point of copper* did not change colour; and they detected the undeniable presence of oxide of chromium in this mineral. According to the author of this paper, the composition, in 100 parts, of the morallon emerald is:- Silica, 67·2; alumina, 19·4; glucina, 12·7; magnesia, 0·4; with traces of oxide of chromium and lime. Formula:—Al_2O_3, $2SiO_3 + GlO_3, 2SiO_3$.

Moniteur Scientifique, No. 312, December 15, 1869.

This number, chiefly filled with a copious index, does not contain any original papers.

Les Mondes, December 9, 1869.

This number contains the following original papers:—

* According to the latest experiments made on this subject by Dr. van Riemsdijk, at the Utrecht Mint, pure copper, kept in a very slow current of pure and dry hydrogen, requires, for fusion, a temperature of 1330° C.

Phosphorescence of the Sea.—M. Duchemin.—This phenomenon, the cause of which has given rise to much speculative discussion, has been thoroughly investigated by the author, who has been occupied with this subject for four years. The results arrived at may be summarised as follows:—The phosphorescence of the sea is solely due to the presence of myriads of very small infusoria (*Noctiluca miliaris*). These animalculæ emit light, produce phosphoreseence, whenever they are agitated, either by mechanical means, by heat not exceeding 39°, for a temperature of 41° kills the animals, and after their death neither electricity, nor the action of cold or alcohol, or the addition of an acid to the sea water, again brings about the phosphoreseence. These infusoria are not killed by a strong degree of cold, which seems rather to excite the phosphoreseence. An addition of 50 per cent of fresh water to the sea water does not affect the infusoria, but if they are placed in entirely fresh water they are killed. The addition to sea water of alcohol and any dilute acid for a moment greatly excites the infusoria, and a brilliant phosphoreseence is the consequence; but the experiment is fatal to them. When the infusoria are kept in perfect darkness for more than a fortnight, they still preserve their faculty of phosphoreseence. Electric currents do not kill these beings, which, according to the author, cause to those bathing in the sea sometimes a peculiar exanthema.

December 16, 1869.

Generateurs inexplosibles (Steam-Boilers which cannot Explode).—MM. Belleville and Co.—This number contains the description, accompanied by several cuts, which merit the attention of all who have to work with steam, especially of high pressure.

Cosmos, December 4, 1869.

The number contains:—

Properties of Vapours (Apparatus Benevides).—M. Benévides.—The apparatus, described and illustrated by a cut, is devised by the author with the view to prove the laws of ebullition, the phenomena of latent heat, the influence of temperature upon the tension of vapours, the mode of action of Giffard's injector, the cold produced by the expansion of very high pressure steam when blown off in the atmosphere, the action of steam as a motive power, and the transformation of the heat of combustion into mechanical force.

December 11, 1869.

Biography of Alexander von Humboldt.—Dr. C. Bruhns.—The author states that this work, of which he is the chief editor, will be published in the following manner:—The general scientific biography of the deceased eminent *savant* will be edited by MM. Avé-Lallemant, Dove, Loewenberg, and Foerster. The second section of the work will contain the following sub-divisions, to each of which the deceased contributed largely:—Meteorology and hydrography, Dr. Dove; physiology, Dr. du Bois Reymond; zoology, Dr. Carus; botany and botanical geography, Dr. Grisebach; geology and mineralogy, Dr. Ewald; geography, Dr. Peschel; astronomy and mathematical geography, Dr. Bruhns; natural philosophy and magnetism, Dr. Wiedermann; Humboldt considered as author, Dr. R. Gosche.

December 18, 1869.

Specific Gravity of the Water of the Black Sea.—M. Lapschine.—While the author, as commander of the Russian navy's corvette *Lwitza* (*Lioness*), was engaged in taking soundings of the depth of the sea above named, he found, at latitude N. 44° 25′ 30″, longitude E. of Poulkowa, 7° 7′, the deepest place, amounting to 1020 toises (1 toise=6 feet and 6 and 9-10ths inches, English measure), the sp. gr. of the water at the surface of this spot was 0·013, while the water from the deeper portions of the sea varied in sp. gr. from 1·0151 to 1·0140. The figure 0·0130, just quoted, is exactly as in the original, but is, presumably, intended for 1·013.

Petroleum Sources near the Caspian Sea.—M. Meunier.—The existence of petroleum in this region of Asia has been known from a remote antiquity, but only of late has this material become utilised; and new borings, made according to the American system, have revealed the fact that, from a depth of 250 feet below the surface, petroleum is forced up so as to spout from 50 to 65 feet above the surface, and to yield quantities amounting to 19,000 000 lbs. annually, while 200,000 lbs. of solid paraffin are obtained from a kind of asphalte, very abundantly met with in this remote region.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, October, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

Bronze Powder.—Dr. Wagner.—After referring to the history of the first application of the scraps and waste of what is commonly called tinsel, or Dutch gold (none of it was or is ever made in the Netherlands; this industry is confined almost entirely to Bavaria), the author treats of the mechanical means whereby the metal is brought to leaf and powder. There are three chief alloys in use, which are designated by the name of the colour, the composition of these being, in 100 parts:—For the light shade—copper, 83; zinc, 17; for the deeper shade—copper, from 90 to 94; zinc, from 10 to 6; for deep copper-red, no zinc at all. Copper may be obtained in finely-divided state by the following chemical means:—By igniting a mixture of chloride of copper, carbonate of soda, and sal ammoniac; by precipitating a solution of acetate of copper by means of sulphurous acid; by decomposing suboxide of copper by means of sulphuric acid; by electrolysis of a solution of sulphate of copper; by precipitating a solution of the last-named salt by means of a bar of iron wrapped up in filtering paper or coarse cotton tissue; but all the metal thus obtained is hard and crystalline, and unsuitable for the purposes it is intended for as bronze powder. The author found that, when oxide of copper, such as is used for elementary organic analysis, is submitted, hot, to the action of the vapours of ligroine (a light petroleum oil, or spirit), it is obtained in an excellent condition, and 100 kilos. of oxide require, for reduction at red heat, only 8 kilos. of ligroine.

Manufacture of Alcohol from Indian Corn.—M. Bergsträsser.—This paper is of interest only to distillers in countries where Indian corn is grown; the material is very suitable for the purpose, and the refuse remaining after distillation is a valuable food for milch cows, on account of the large quantity of fatty matter it contains.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, July and August, 1869.

The papers on chemical subjects in these two numbers have been forestalled by having been published in other German periodicals, from which we abstracted them.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 143, 1869.

This number does not contain any original papers relating to chemistry or allied sciences.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, October, 1869.

This number contains the following original papers:—

The Doctrines of Modern Chemistry.—Dr. Koller.—This paper contains a very clear review of the doctrines of modern chemistry, as compared with that of some years ago. The contents of this paper are divided into sections with the following headings:—Atomic and molecular weight; type and radical theory; substitution; anhydrides of acids; anhydrides of bases; salts, normal, basic, and acid. The paper is not well suited for useful abstraction.

On Gelatinæ Medicatæ.—Dr. Husemann.—This paper relates entirely to the pharmaceutical preparation of medicated gelatine lozenges.

Lithoreactive.—M. Weiss.—The author states that a mixture containing 5 per cent of sugar molasses, or beet-root syrup, 15 per cent of milk of lime (one part of slaked lime to three parts of water), and 80 per cent of caustic soda lye at 34° Beaumé, sp. gr. 1·039, is the best and surest means of preventing, as well as of breaking-up and dissolving, steam-boiler incrustations, while, moreover, this mixture is perfectly innocuous as regards its action upon either copper or iron. The hardest water only requires 1 kilo. of lithoreactive upon 1800 litres of water.

Antimonoide.—M. Lichtenberger.—Under this curious name, there is in use a mixture for absorbing the protoxide of iron, while that metal is to be welded in red-hot state. The mixture consists of 4 parts of iron filings or turnings, 3 parts of borax, 2 parts of borate of peroxide of iron, and 1 part of water. The powder is made in the following manner:—To a solution of 3½ parts of borax in water, as much chloride of iron is added as is sufficient to obtain a precipitate of insoluble borate of peroxide of iron; this precipitate is washed upon a filter to remove common salt. This having been done, there is added to the precipitate (previously, of course, put in a suitable vessel) a solution of 3 parts of borax, and this mixture evaporated nearly to dryness, when there is added to it 4 parts of clean iron filings or turnings. The whole is then strongly dried and heated to incipient red-heat, whereby a fusion takes place; and, after cooling, the mass is pulverised.

Comptes Rendus des Séances de l'Académie des Sciences, December 20, 1869.

This number contains the following papers and memoirs relating to chemistry or sciences allied thereto:—

Distribution of Potassa and Soda in Plants.—M. Peligot.—This is a third paper on this subject, and the author treats in it the question whether plants have the faculty of absorbing the alkaline substances contained in the soil, and also whether they can, by any choice, assimilate the salts of potassa in preference to those of soda. The main points of this paper are:—(1) That soda is met with in plants in several distinct forms; this alkali is taken up by the radicles, penetrates into the tissues of the plants, and is found among the mineral matter left after incineration of the same. (2) In some marine plants, soda exists, in the form of salt water, in the sap which fills the tissues of these succulent vegetables. (3) All plants grown sufficiently near the sea-board contain chloride of sodium dispersed over their surface; but the presence of this salt in the ash of such plants does not imply that this salt has contributed to the development of the plants. The discussion of this paper gives rise to a statement of facts observed last autumn by M. Elie de Beaumont, who says that, while staying at Canon, Department du Calvados, and at a distance of 23 kilometres (about 14·3 English miles) from the coast, he observed that, during a severe W. S. W. gale, the leaves of the trees of that part of the country were, so to say, burnt up; and he ascribes this to the pulverised sea-water dust carried inland by this gale, proving that at a great distance from the coast sea-salt may be mechanically brought over.

Observations on the Communication of M. Soret, bearing upon the Illumination of Transparent Substances.—M. Lallemand.

Formation and Duration of Induced Currents.—M. Blaserna.—Both physico-mathematical papers.

Electro-Motor Force Developed by Platinum when it is brought into Contact with Various Liquids.—M. Gaugain.—The contents of this paper may be resumed as follows:—(1) That unplatinised platinum which is left for some time in an acid liquid is gradually modified, and thus becomes, after a shorter or longer lapse of time, more positive than it was at the moment of its first immersion. (2) That platinised or unplatinised platinum which is placed in an alkaline fluid becomes gradually more negative.

Researches on the Preparation and Purification of Sulphide of Carbon.—M. Sidot.—The chief results of the experiments made on this subject by the author prove that a full red heat is the best temperature for obtaining the largest quantity of sulphide of carbon from a given weight of sulphur in the state of vapour and charcoal. At a low red heat (*rouge sombre*), as well as at a bright red heat (*rouge vif*), the formation of this sulphide takes place, but the quantity obtained is by far smaller. As regards the purification, the author first re-distils the raw product, then shakes the distillate up with mercury, until the latter becomes black, and this operation is so long repeated as the metal is affected by the fluid, or, rather, by any sulphur dissolved in it. Sulphide of carbon thus purified is freed from the fœtid odour it generally has, and exhibits a smell of ether.

Composition of the Skin, the Modifications it undergoes by Tanning, and the Fermentation of Tannin in the Tan-Pits.—M. Müntz.—The author has investigated the skins and hides during the three principal stages of the operation of tanning it. In fresh state, skin contains from two-thirds to three-fourths of its weight of water; dried at 110°, it becomes one of the most hygroscopical substances we are acquainted with. The immediate analysis of skin led to the following results for 100 parts:—Cellular tissue not acted upon by boiling water, 3·080; fatty matter, 1·058; mineral matter, 0·467; substances capable of forming gelatine, 95·395. During the tanning, the substance fixed in and upon the skin is not tannin, but a derivative thereof, which may be denominated tanning material (*matière tannante*), which differs from tannin in this respect—that it contains less oxygen and more hydrogen. The fermentation going on in the tan-pits takes place with exclusion of air, and gives rise to the formation of lactic, acetic, gallic, formic, and carbonic acids, while a small quantity of propionic acid is also formed.

An Error Committed in Saccharimetrical Estimations.—M. Maumené.—We intend to give a full translation of this paper at a future period.

Annalen der Chemie und Pharmacie, November, 1869.

This number contains the following original papers and memoirs:—

Balsam of Peru.—M. Kraut.—Among the substances originally only known and used in pharmacy, very few have given rise to such a number and such protracted investigations as the balsam just alluded to. The author of this paper has tried to reconcile, and bring into proper harmony, the researches of all his predecessors, and states that the oil of balsam of Peru (the cinnameine of Frémy) has been prepared by him by acting upon the original balsam with a mixture of ether and soda-lye containing about 4 per cent of soda. The ethereal solution is first washed, next deprived of the ether by distillation, and then the oil dried at 120° in a current of pure and dry hydrogen. By fractional distillation, this oil may be separated into three different portions:—(*a*) boils at 200°, and yields, on analysis, C_7H_8O; is converted into benzoic acid, without any evolution of carbonic acid, by the action of chromic acid. (*b*) boils at 300°, contains 79·09 per cent C and 6·0 per cent H, and was found to be benzoate of benzyl ether, a colourless fluid of the consistency of sweet oil of almonds; sp. gr. at 18·5°, 1·114; formula, $C_7H_7.O.C_7H_5O$. (*c*) boils at the boiling-point of mercury; sp. gr. at 23°, 1·050; this substance is cinnamate of benzyl ether—formula, $C_7H_7.O.C_9H_7O$; the dark coloured-residue remaining in the retort is styracine. When the oil, as originally

obtained, is submitted to the action of caustic potassa dissolved in alcohol, and the resulting substances examined, the author found:—(*a*) Cinnamate of ethyl ether, $C_2H_5.O.C_9H_7O$; (*b*) benzyl alcohol, boiling at 206·2; sp. gr. at 19°, 1·0465; not solidified at −18°; formula, $C_7H_7.O.H$. The chief constituents of balsam of Peru are—Free cinnamic acid, resin, and the benzyl ethers of benzoic and cinnamic acid.

Action of Sulphurous Acid upon Chloride of Platinum.—M. Birnbaum.—When platino-chloride of ammonium is mixed with an aqueous and concentrated solution of sulphurous acid, care being taken to keep the latter in excess, a yellow solution is obtained which, on being concentrated by evaporation on a water-bath just to the point of crystallisation, and then further dried over sulphuric acid, after addition of some sulphurous acid solution, yields a salt—

$$Pt\left\{\begin{matrix}Cl\\HSO_3\end{matrix}\right\}+2NH_4Cl.$$

This compound is to be considered as a monobasic acid, a view fully confirmed by the fact that, instead of the two molecules of chloride of ammonium, chloride of potassium, or sulphate of ammonium can be taken up. The potassium salt is—

$$Pt\left\{\begin{matrix}Cl\\KSO_3\end{matrix}\right\}+2NH_4Cl.$$

When ammonio-chloride of platinum is treated with acid sulphite of ammonium, a salt is obtained—

$$Pt\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\}+2NH_4Cl+H_2O.$$

Octyl Compounds.—M. Schorlemmer.

Derivatives of Propan.—M. Schorlemmer.

Action of Bromine upon Ether.—MM. Ladenburg and Wichelhaus.—The action of bromine upon compounds of organic origin is either a substitution or an addition, so that the halogen is found instead of H, or has become incorporated with the organic molecule which is thereby saturated; but this action is not that commonly met with when bromine acts on the substances known as "ethers," since very frequently the halogen in these instances combines with the radical (*e.g.*, C_2H_5), and, while displacing O, causes an intrinsic change of the molecule. The authors have investigated this action more especially with Kay's ether (orthoformic ether), boiling between 146° and 148°; bromine acts upon this fluid, even at the ordinary temperature, forming bromide of ethyl and carbonic ether. The reaction of the halogen upon this orthoformic ether is represented by the following formula:—

$$2CH(OC_2H_5)3+Br_2=$$
$$=2BrC_2H_5+CO(OC_2H_5)_2+CHO(OC_2H_5)+C_2H_6O.$$

The authors also investigated the action of bromine upon ortho-carbonic, ethyl-glycolic, and ethyl-lactic ether.

Contribution to Our Knowledge of Selenium.—M. Rathke.—This monograph is divided into the following sections:—The allotropic modifications of selenium, and their relation to those of sulphur; sulpho selenium; seleno carbon; selenium-xanthogenic acid; experiments made for the purpose of forming selenium-tetrethyl and sulpho-tetrethyl; ethyl-selenious acid.

Preparation of Zinc Ethyl.—M. Rathke.—The preparation of zinc ethyl, according to the method suggested by MM. Beilstein and Alexeyeff, is rendered of far easier execution when there is added to the mixture of iodide of ethyl and zinc (with or without the addition of sodium amalgam) a small proportion of zinc ethyl from a former operation. The author states that the formation of zinc ethyl is thereby accelerated to such an extent as to admit of the entire operation being finished, by the aid of the heat of a water-bath, in half an hour. When 2 grms. of zinc ethyl are added to 100 grms. of iodide of ethyl, the action becomes sometimes so violent as to necessitate the withdrawal of the source of heat and cooling of the retort wherein that action takes place.

Di- and Tri-Chlorobenzoic Acid.—MM. Beilstein and Kuhlberg.—Tenth portion of a memoir on the subject of "Isomerism of the Benzoic Group." This portion of the monograph is divided into the following chapters:—Dichlorobenzoic acid from dichlorotoluol; dichlorobenzoic acid from benzoic acid; trichlorobenzoic acid from trichlorotoluol; alcohol of trichlorobenzoic acid, $C_6H_2Cl_3.CH_2HO$; trichlorobenzoic acid from benzoic acid.

Action of $SbCl_5$ upon Chloride of Toluol.—MM. Beilstein and Kuhlberg.—The authors, referring to a treatise they published in vol. CL. of this periodical (title not given), now state that when chlorine is passed into boiling tetrachlorotoluol chloride, $C_6HCl_4.CH_2Cl$ (boiling-point, 296°), they obtained, by the fractional distillation of the products of this reaction, a fluid boiling at about 285°, from which, at 84°, crystals were deposited, which proved to be pentachlorobenzol, $C_7H_2Cl_6$. When trichlorotoluol is acted upon by chlorine at its boiling-point, the authors obtained therefrom a substance (tetrachlorobenzol) boiling at 240°, fusing at 140°; formula, $C_7H_3Cl_5$.

Toluchinones.—M. Borgmann.—Trichlorotoluchinon, $C_7H_3Cl_3O_2$, a solid substance exhibiting yellow-coloured crystals; difficultly soluble in cold, but more readily in boiling, alcohol; very readily soluble in ether and chloroform; and readily decomposed by heat. Trichlorotoluhydrochinon, $C_7H_5Cl_3O_2$.—Needle-shaped crystals, readily soluble in alcohol, and fusing at 212°. Biacetyltrichlorotoluhydrochinon—

$$C_6Cl_3\left\{\begin{matrix}CH_3\\O.C_2H_3O\\O.C_2H_3O\end{matrix}\right.$$

a crystalline solid, readily soluble in alcohol and ether, and fusing at 114°. Biethyltrichlorotoluhydrochinon—

$$C_6Cl_3\left\{\begin{matrix}CH_3\\O.C_2H_5\\O.C_2H_5\end{matrix}\right.$$

also a solid substance, fusing at 107°. Monochlorotoluhydrochinonbisulpho acid—

$$C_6Cl\left\{\begin{matrix}CH_3\\OH\\OH\\(SO_3H)_2\end{matrix}\right.$$

a salt soluble in hot water, insoluble in alcohol, and crystallising in leafy-shaped crystals.

Supplementband, vol. vii. No. 1.

This number contains the following original papers and memoirs:—

On Mellitic Acid.—M. Baeyer.—From this very lengthy essay, we quote that mellitic acid was discovered by M. Klaproth, in a mineral called honeystone. The author refers, at some length, to the researches made by MM. Wöhler, Liebig, Erdmann, Gerhardt, and others on this subject, and then states that, according to his own investigation, the most simple formula for mellitic acid is $C_{12}O_{12}H_6$; that is to say, that this acid is a benzol all the H of which has been replaced by the carboxyl group, CO.OH. This is fully proved by the fact that, when mellitic acid is decomposed in contact with soda-lime or lime at a high temperature, benzol and carbonic acid (carbonate of lime) are formed. This treatise is divided into the following sections:—Mellitic acid, which the author says is a sexbasic acid and a rare substance, since the mineral from which it is obtained is very sparingly found. Hydromellitic acid, $C_{12}O_{12}H_{12}$, also a sexbasic acid, obtained from mellitic acid by the action of sodium amalgam. Action of sulphuric acid upon hydromellitic acid, assisted by heat; the products of this action are carbonic acid, a quadribasic,

and a tribasic aromatic acid—viz., isopyromellitic acid, $C_6H_2(CO_2H)_4$; and trimesinic acid, $C_6H_3(CO_2H)_3$. Hydroisopyromellitic acid, $C_{10}O_8H_{10}$. Hemimellitic acid, $C_9O_6H_6$. Pyromellitic acid, $C_{10}H_6O_8$. Hydropyromellitic acid, $C_{10}H_{10}O_8$. Action of sulphuric acid and heat upon hydropyromellitic acid. Trimellitic acid, $C_9H_6O_6$. Isohydromellitic acid, $C_{12}H_{12}O_{12}$. Action of sulphuric acid and heat upon isohydromellitic acid. Action of bromine upon hydromellitic acid. Benzolcarbon acids. Hydrobenzol-carbon acids. It should be mentioned that this paper is only the first part of the author's essay on this subject.

Indol.—M. Baeyer.—Indol can be obtained from indigo by two different methods—viz., by causing the vapours of oxindol to pass over heated powdered zinc; or, also, by heating, with the same metal, the yellow material obtained when indigo-blue is treated with tin and hydrochloric acid. From the author's statement, it appears, however, that indol is a substance which is difficultly prepared and very difficult to obtain in pure state. When pure, indol is a solid substance, soluble in water, crystallisable, fusing at 52°, and readily soluble in alcohol, ether, and hydrocarbons; it is a weak base, not forming salts very readily. Composition, in 100 parts:—C, 82·05; H, 5·98; N, 11·97. Formula, C_8H_7N. Indol is characterised by the peculiarity of producing red-coloured combinations. When the alcoholic solution of indol is mixed with hydrochloric acid, it tinges a piece of fir-wood placed therein cherry-red in a few minutes. The author states that M. Kühne has found indol in the products of decomposition of the pancreatic juice.

New Method of Formation of Monobromacetic Acid.—Dr. Gloeckner.—The author describes, in this essay, a series of experiments made with bromethylen-bromide, $C_2H_3Br_3$, and obtained, especially by treating this substance in sealed tubes exposed to a higher temperature, and containing various substances (as, for instance, BaO, KaO, and water) along with the bromethylen-bromide, among other products, monobromacetic acid.

Action of the Haloids upon the Metallic Derivatives of some Carbon Compounds.—M. Bunge.—The author prepared silver succinimide by boiling pure succinimide with water and oxide of silver. The silver succinimide thus obtained was treated with iodine, and, by means of many carefully executed operations, crystals of pure iodide of succinimide were obtained. This compound is very prone to decomposition, especially when heated, since it cannot bear 100° without very perceptible alteration; it is readily soluble in aceton and water, but difficultly in alcohol and ether. The author obtained, with difficulty, some other compounds, but not in state of sufficient purity for analysis, and failed to substitute cyanogen for the atom of nitrogen which is combined with H in succinimide. Some experiments were also made relating to the action of vapours of bromine upon dried benzoate, oxalate, and succinate of silver; the products hereby obtained are bromobenzoic acid, bromide of silver, and succinic acid.

Zeitschrift für Chemie von Beilstein, No. 22, 1869.

The number contains the following original papers:—

On Cytisin.—Dr. A. Husemann.—This paper contains the account of some additional experiments on this subject, which was briefly abstracted by us from another paper (see Chemical News, vol. xx., p. 36; *Am. Repr., Sept*, '69, *page* 178). The formula of cytisin is $C_{20}H_{27}N_3O$; it fuses at 154·5°, and can be sublimed when the heat is properly regulated. The nitrate of this base, $C_{20}H_{27}N_3O$, $(HNO_3)_2+2H_2O$, is the only salt which crystallises well; it is soluble in water and dilute alcohol; its taste is far more bitter than that of the base itself. The hydrochlorate of cytisin, $C_{20}H_{27}N_3O.4HCl+3H_2O$, is a salt very soluble in water. With the following acids, cytisin yields deliquescent salts:—Sulphuric, phosphoric, formic, acetic, propionic, butyric, valerianic, oxalic, and tartaric. With the chlorides of platinum, gold, and mercury (bichloride), cytisin yields double salts, which can be obtained in crystalline state. Among the large number of reactions discovered by the author for the easy detection of this base, the most sensitive are:—A solution of iodine in iodide of potassium produces, even in the most dilute solutions of cytisin, a deep red-brown precipitate, which is at first amorphous, but becomes, when left standing, converted into beautiful transparent deep-red prisms. Bromine water produces, even in solutions containing only 1-15000th part of the base, a distinct cloudiness, and in more concentrated solutions, an orange-coloured precipitate. Chlorine water does not yield any precipitate or cloudiness at all. Cytisin is found in all parts of the well-known tree, *Cytisus laburnum, L*, except in the wood; the ripe seeds contain a large quantity of this very dangerous substance, which is a poison, whether it be ingested into the alimentary apparatus or subcutaneously applied. From 3 to 5 decigrms. of cytisin, subcutaneously applied, will kill a large dog within half an hour.

On Isomeric Chlorotoluidines.—M. Wroblevsky.—When pure chlorotoluol is gradually treated with nitric acid (sp. gr., 1·475), the author succeeded in obtaining, after having twenty-six times repeated a fractional distillation, two nitro products, one of which boils at 243°, and the other at 253°; the sp. gr. of the former was found to be 1·307, and of the latter 1·325, both at 18°. The product boiling at 243° is designated by *a*, the product boiling at 253° by *β*; the formulæ are—*a*, $C_7H_6Cl(NO_2)$; *β*, $C_7H_6Cl(NO_2)$. Both bodies having been treated with fuming sulphuric acid, yield a sulpho acid; the baryta salt of that acid of the *a* kind is a readily crystallisable salt, rather difficultly soluble in water—formula, $(C_7H_5ClNO_2SO_3)2Ba+4H_2O$; the baryta salt of the *β* kind is so readily soluble in water that it is impossible to obtain it in pure state. *a* chlorotoluidine, obtained from *a* $C_7H_6Cl(NO_2)$, by the action of Sn and HCl, is a fluid, sp. gr. at 20°, 1·185, boils at 238°, is not solidified at — 14°, insoluble in water, and readily soluble in alcohol; *β* chlorotoluidine is a solid (when pure) crystallising in large foliated crystals, fuses at 38°, boils at 241°, almost insoluble in water, and readily soluble in alcohol. Both these substances yield crystallisable salts.

Contribution to the Knowledge of Sulpho-Nitrogen Acids (Schwefelstickstoffsaeuren).—MM. Claus and Koch.—When neutral aqueous solutions of nitrite of potassa and sulphate of potassa are mixed together, there will be at first formed a cloudiness, or turbidity, shortly followed by the appearance of a quantity of needle-shaped crystals, while the solution becomes, simultaneously, distinctly alkaline to test paper. If concentrated solutions of the salts referred to are mixed, the reaction is finished in a couple of minutes, and the mass has become a thick magma, while, at the same time, the temperature of the mixture sometimes rises to 80°. The authors have investigated this salt, and studied many of its derivatives; the salt alluded to, tetrasulphammoniate of potassa (*tetrasulfammonsaureskali*).

$$K_4HNS_4O_{12}+3H_2O=4\left(S\begin{matrix}OK\\O_2\end{matrix}\right)1\Big\}.NH_3,$$

is formed according to the following equation:—

$$4(K_2SO_3)+KNO_2+3(H_2O)=5(KHO)+K_4HNS_4O_{12}.$$

The authors describe, at length, the mode of preparation and analysis of trisulphammoniate of potassa—

$$3\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH_2,$$

obtained from the foregoing salt by the action of water upon it according to the formula—

$$4\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH+H_2O=3\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH_2+KHSO_4,$$

of a disulphammoniate of potassa—

$$3\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH_2+H_2O=2\left(S\begin{matrix}OK\\O_2\end{matrix}\right).NH_3+KHSO_4.$$

The preparation and mode of analysis of these salts require very delicate manipulation.

Chemical Constitution of Pyroxiline (Gun Cotton).—Dr. Gintl.—The author states that when gun cotton, and also the collodion wool, are thoroughly moistened with concentrated sulphuric acid, after having been previously washed with water, so as to remove any matters present therein soluble in water, and left quietly standing in a well-closed suitable vessel, the substances will be dissolved and converted into a colourless, syrupy fluid. When this fluid is cautiously diluted with water, so as to prevent any increase of temperature, and next saturated with carbonate of baryta, and the excess of the latter salt, along with the sulphate of that base, are removed by filtration, there is obtained a perfectly colourless fluid, which, after having been evaporated *in vacuo* over sulphuric acid, leaves a gum-like mass, containing crystals of nitrate of baryta. The gum-like matter consists chiefly of the baryta salt of ligno-sulphuric acid (*holzschwefelsäure*), which may be obtained in free state by very cautious and careful removal of the baryta, by means of dilute sulphuric acid. Ligno-sulphuric acid was first discovered by Braconnot.

Revue Hebdomadaire de Chimie, December 9, 1869.

Quantitative Estimation of Sulphur in Cast-Iron and Steel.—M. Eggertz.—The process invented by this author is based upon the shade of colouration which small quantities of sulphuretted hydrogen produce upon pure silver, or certain alloys thereof. In a glass stoppered bottle, of 25 centimetres diameter and 15 decimetres height, a mixture is poured of 1 grm. of water and ½ a grm. of concentrated sulphuric acid, to which is added 1 decigrm. of the metal reduced to the finest possible powder. There suspend, by means of a very fine platinum wire, in the bottle, without touching the fluid, a clean piece of metallic silver, the platinum wire being held squeezed between the stopper and the neck of the bottle. The metal dissolves in a moderately warm room within a quarter of an hour, so that the silver can be taken out and examined after that time. The author has, by means of a series of experiments, been enabled to construct a series of numbers, representing, according to certain shades of colouration, the quantities of sulphur found.

Drop Apparatus for Fluids.—MM. Alvergnat, Frères.—This contrivance consists essentially of a flat-bottomed glass flask, round the top portion of which a caoutchouc balloon has been so arranged, that a glass tube bent downwards outside of the flask, and reaching straight down to the bottom, passes air-tight through the balloon. When the latter is compressed, the air it contains forces the liquid in the flask upwards; and this may be so managed as to cause it to flow drop by drop out of the bent tube.

Among the papers, the titles of which we notice, but do not abstract, because they are too lengthy, and do not, moreover, belong to chemical science, are the following:—

Process for the Reproduction of Pictures by Lithography and other means.—M. Mielle.

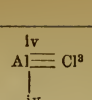
Furnace Constructed to Burn Spent Tan for the Purpose of Heating Steam-Boilers.—MM. Durand, Frères, 17, Rue de Gobelius, Paris.

NOTES AND QUERIES.

Reducing the Metal from Impure Chloride of Zinc.—Can any of your readers inform me of a practical and profitable method of reducing the metal from impure chloride of zinc?—An Old Subscriber.

Aluminium Sulphide and Phosphide.—(Reply to "D. H.")—See Berzelius's "Traité de Chimie," vol. ii., p. 157 (Paris, 1846), and "Handbook of Chemistry," by Gmelin, vol. iii., pp. 309 and 311. Both works may be inspected at the Library of the Commissioners of Patents.

Atomicity of Aluminium.—(Reply to "Dubitans.")—Aluminium is tetratomic and pseudo-triatomic, like carbon. In the simplest formulæ of aluminium compounds, the metal is represented as triatomic, as, for example, $Al'''Cl_3Al'''K'2SO_4 + 12H_2O$; but the specific gravity of the vapour of aluminium chloride shows that the true formula is Al_2Cl_6, and not $AlCl_3$. Hence it is probable that each aluminium atom is really tetratomic, the constitution of the chloride being—



—Atomicity.

Gas and Oil Furnaces.—No one seems inclined to give me the information as to getting up white heats in a small furnace with ordinary gas from the mains, from which I infer no one of the readers of the Chemical News has done it, nor sees his way how to do it. As I find, on inquiry at the gas office here (Runcorn), that they will not allow any reduction in price for use in such quantity, save some 2½ discount, I must try oil of some sort or other. Which is best for my purpose? I want to have as *clean* a heat as possible—that is, free from sulphur and deposit of any kind that would interfere with the action of the vapours I introduced on the clay goods in the kiln. At first thought, you would fancy a flame from oil should not leave any deposit; but I am not so sure, as the gas from a gas producer of Siemens's covered the goods with brown-red dust.—J. C.

Glue and Gelatine.—I would feel obliged if any one would refer me to the memoirs which have been published on glue and gelatine, or to any special source of information on these subjects.—G. G.

Utilisation of Sulphate of Lime.—Will any of your readers, through your columns, kindly inorm me of some process, for some book which treats of such process, by which the sulphate of lime obtained in neutralising the superfluous acid when making Glauber's salt, can be turned into manure or any other salable article.—Glauber.

Gas and Oil Furnaces.—Your correspondent ("Runcorn"), I think, would find creosote do for his purpose; it is used by the Government for melting metal, &c., at Woolwich. The heavy tar oil is burnt in contact with steam, perfect combustion thereby taking place. Should he address himself to me at the Post Office, near Mark Lane, Fenchurch Street, I would give him the necessary information.—R.

Testing Lemon-Juice.—I wish to know what process is followed by analytical chemists in testing concentrated lemon-juice as used by calico printers—viz., to ascertain quantity of citric, tartaric, sulphate, and oxalic acids, chlorides, iron, or any other contaminations contained therein—and should feel obliged if you would, through the medium of your valuable paper, give me the name of some work where I could meet with the information.—A. S.

Bronze for Leather.—Can any of your readers give me the composition of the dye used in giving a rich reddish brown metallic (bronze) appearance to leather? It is altogether a vegetable dye—or, at least, it is either animal or vegetable—because it leaves no residue on combustion. Your correspondent refers to the bronze now so general on ladies' boots and shoes.—A Constant Reader.

Reducing the Metal from Impure Chloride of Zinc.—(Reply to "An Old Subscriber.")—Not having stated what are the impurities, it is somewhat difficult to advise on the subject, but perhaps the following plan will answer:—Make a moderately strong aqueous solution of the chloride; add powdered dry chalk in a very slight excess. You thus obtain carbonate of zinc, while chloride of calcium will be in solution. Wash the carbonate of zinc, dry it, and mix it with powdered charcoal and some crude oil, taking care to have excess, by weight, of the former of these substances. Place this mixture in a fire-clay retort, or apply the well-known English zinc-melting method. You will require a very strong heat. The zinc, being a volatile metal, will distil.

Acacia Charcoal.—Japanese Fireworks.—Acacia charcoal is now given as a medicine, sold at a high price, the vendors averring that acacia charcoal, and acacia charcoal alone, is the only efficacious material; in fact, that no other charcoal "need apply." I doubt this. Will any of your chemico-medical readers kindly give me information, or an opinion on the subject.—The pretty little Japanese fireworks, for which I sent you a formula once upon a time, have frequently failed in the hands of my friends. I find the cause to be the enormous degree of adulteration in the flour sulphur; crystallise this from benzol, and all goes well; in this case, an additional part of sulphur is required. Roll brimstone would probably be pure enough.—R. Trevor Clarke.

Testing Lemon-Juice.—"A. S." is referred to O'Neill's "Chemistry of Calico Printing and Dyeing, &c.," page 140 and following pages.

Glue and Gelatine.—(Reply to "G. G.")—See "Knapp's Technology," English edition, by Dr. Richardson and Mr. Watts; see Wagner's "Hand und Lehrbuch der Technologie," vol. v., p. 80 and following pages.

Mellite or Honeystone is a rather rare mineral, consisting of mellitic acid, alumina, and water; its colour is honey-yellow; it occurs in brown coal in Thuringia, near Bilin, Bohemia, and in a few other localities.

Utilisation of Sulphate of Lime.—(Reply to "Glauber.")—Sulphate of lime, whether it be precipitated, or the native sulphate ground into powder, is useful as a manure by itself. If the article you allude to is very white and pure, it may find a sale among paper-makers.

Bronze for Leather.—(Reply to "A Constant Reader.")—It would be impossible to give you the composition of such a substance as you allude to without actually testing the material; but it is very likely that the substance used is a strong alcoholic solution of aniline purple, which is applied for bronzing purposes.

Acacia Charcoal.—(Reply to R. Trevor Clarke.)—This is probably inferior to willow charcoal; the latter makes a very soft smooth powder, and mixes readily with water. The wholesale price varies from 1s. 4d. to 1s. 6d. per lb. Logwood charcoal has been sold under the name of "the immortal carbon."—G. A. K.

Acacia Charcoal.—(Reply to R. Trevor Clarke.)—You are quite correct as to your surmise concerning acacia charcoal; refer to Pereira's "Materia Medica," 4th edition, vol. i., page 320 and following. Wood charcoal obtained from the lime, or linden tree, *Tilia Europea*.

L., is officinal in some Pharmacopœias. The cause you suggest of the failure of the use of flowers of sulphur is, we think, wrong; the reason is that, unless flowers of sulphur have been washed, they always contain sulphuric acid. Roll sulphur only is used in the powder manufacture for the same reason.

Analysis of Nitrous Oxide.—Happening to meet with a copy of Roscoe's "Elementary Chemistry," and looking over the article "Nitrous Oxide," I find he asserts that, after analysis of the gas by potassium in a bent tube over mercury, the products, after combustion of the metal in the gas, are nitrogen and potassium hydroxide, KHO! Where does the H come out of? Will Professor Roscoe kindly explain this?—VERITAS, Liverpool.

Specific Gravity.—Would you kindly favour me with an answer to the following question:—I read of solutions as being of sp. gr. 1·053, &c. Now what is the rule for determining these strengths by Twaddle's hydrometer; or, in other words, how may I know the rule for calculating these strengths, that when I see the sp. gr. I may calculate them, so as to be able to know at what number of degrees is equal on Twaddle's? I should be glad if you would enlighten me on this point. —CHAS. H. PARKIN.

Electro-Deposition of Copper upon Cast-Iron.—In attempting the above, the writer finds great difficulty in obtaining adhesion between the copper and the rough surface of the cast-iron, previously cleansed by dilute sulphuric acid. Whether the deposit be made slowly or quickly, it is soon separated from the iron by a black powder, which appears to consist chiefly of carbon, silica, &c. Information, or reference to treatises, will be much esteemed by HISTRIX.

Treatment of Oils for Machinery Purposes.—Can any of your readers supply any information upon the process of refining animal and vegetable oils, having special regard to the abstracting the gummy or albuminous matter, without introducing any acids that would be injurious to the machinery afterwards; or perhaps they could recommend some work which treats on the subject.—B. S.

Gas and Oil Furnaces.—"J. C.," who enquires about gas and oil furnaces, in the CHEMICAL NEWS of September 24th and December 3rd, will find the coke produced in distilling crude anthracene and coal-tar grease from asphaltum to yield him the intense heat he requires, practically free from sulphur and deposit. It could be used in the Siemens regenerative furnace or otherwise.—WM. SCHOFIELD.

Electro-Deposition of Copper upon Cast-Iron.—(Answer to "Histrix.")—Among the many treatises on electro-metallurgy the "Repertorium der Galvanoplastik und Galvanostegie, &c.," von A. Martin, published at Vienna, is one of the best, and contains very ample information on this subject. This work can be inspected at the Patent Office Library.

Specific Gravity.—(Answer to "C. H. Parkin.")—According to Twaddell's scale, 0 is equal to 1000, or the specific gravity of distilled water, and each degree is equal to 0·005; so that by multiplying this number by the number of degrees marked on the scale, and adding 1·0, the real specific gravity is obtained. There are published tabular forms giving the specific gravity for every degree of Twaddell's hydrometer.

Knife-Edges for Balances.—(1) Is a balance with agate edges as delicate in its indications, and as prompt in its action, as one with steel edges? [A balance with agate edges is as delicate in its indications, and as prompt in its action, as one with steel edges.]

(2) Is a balance with agate edges more liable to get out of order? [It is not so liable to get out of order.]

(3) If there be an advantage in the agate above the steel, is it worth the increased cost?—W. H. D. [Steel rusts in a damp atmosphere, or if kept in laboratory. Agate edges are well worth the extra cost.]

Treatment of Oils for Machinery Purposes.—(Answer to "B. S.") —Oils for machinery purposes, and for lubricating generally, may be purified by agitating them with from 4 to 8 per cent of their weight of a caustic soda lye, sp. gr. 1·2. After twenty-four hours' repose, the supernatant oil is decanted from the soapy sediment, thoroughly washed with pure cold water, left to repose, again decanted, and filtered, best through some animal charcoal, such as is used for the filtration of sugar syrups in sugar refineries, and through the woollen tissue, also in use in these establishments. This treatment renders the oils very suitable for the purpose intended, and is quite free from any action on the metals.

Glue and Gelatine.—In reply to the enquiry of "G. G.," he will find every information in the admirable articles "On Gelatine and Glue," in Dr. William Allen Miller's "Elements of Chemistry," where the subject is thoroughly treated. I just add a test for the goodness of glue, which I have found very valuable. Assuming that "that" is the best glue which will take up most water—Take 50 grs. of the specimen, and dissolve it in 3 ozs. of water in a water-bath. When dissolved, set it by for 112 hours, to gelatinise; then take a 1 oz. chip box, place it on the surface of the gelatine, and put "shots" into the box, till it sinks down to a "mark" on the outside. It will be found that, the stronger the glue, the more shots it will take to sink the box down so that the mark shall be level with the surface of the gelatine. In a trial with Mitchell's glue, which is made here, and is the finest I ever met with, 50 grs. of glue, dissolved and gelatinised, with 3 ozs. of water, supported, to the mark on the box, 6 ozs. of shots, at a temperature of 58° F. On trying the same experiment with best Russian isinglass, 50 grs., dissolved in 3 ozs. of water, supported 9 ozs. of shots, the temperature being the same. Russian isinglass, therefore, is one-third stronger than glue in gelatinising power; but, as Russian isinglass is worth £84, and best glue is worth but £3, the cwt., there is no fear that the former will ever supersede the latter.—ALFRED BIRD, Birmingham.

Electrotyping Cast-Iron with Brass.—Can any of your readers kindly inform me if there is any known method of electrotyping cast-iron with brass?—E. B.

Dissolving Resin in Water.—Will any of your readers kindly inform me whether there is any process by which ordinary resin can be dissolved in water without losing its clearness and natural orange colour; and, if so, what the process is?—J. MILTON.

Analysis of Nitrous Oxide.—(Reply to "Veritas.")—Happening to possess a copy of Roscoe's "Elementary Chemistry," and looking over the article "Nitrous Oxide," I find that he does not assert that, after analysis of the gas by potassium, in a bent tube over mercury, the products, after combustion of the metal in the gas, are nitrogen and potassium hydroxide, KHO; but he says that the products of the combustion are solid potassium oxide, or potash, and nitrogen.—W. K.

Native Carbonate of Baryta.—Will any of your readers kindly inform me, through the medium of your valuable paper, what are the principal applications of native carbonate of baryta, and what is about its market value?—A READER.

[Commercial value, according to purity, from 8s. to 9s. 6d. per cwt. Is applied for the manufacture of salts of baryta, for the preparation of caustic baryta, and also in glass-making.]

Alumina from the Island of Eubœa.—Can any of your correspondents inform me about the "Alumina" obtained from the Island of Eubæa, its price, and through whom it may be obtained. Samples required, which would probably lead to business.—J. E. N.

Dissolving Resin in Water.—(Answer to "J. Milton.")—You cannot dissolve resins in water as you can salt, or sugar, or gum; but shellac, for instance, may be rendered soluble in water by means of a solution of borax, and by means of aqueous solutions of caustic and carbonated alkalies, many (not all) resins may be rendered what can be termed soluble in water; but in reality this is attended with a kind of saponification similar to that which occurs when neutral fats are treated with caustic alkalies, thereby becoming soluble soaps.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of THE CHEMICAL NEWS *give notice that, in accordance with a suggestion of* MR. CROOKES, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* MR. CROOKES *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

R. K.—Picrate of potash explodes on concussion; detonation is greatly increased by the addition of chlorate of potash.

T. C. Winton, A.B., M.D.—Victoria orange may be obtained of Messrs. Roberts, Dale, and Co., Manchester.

Librum.—Fresenius's "Qualitative and Quantitative Analysis," published by Churchill.

R. H.—Any person can receive fees as an analyst without passing an examination or proving his competency.

Captain Ross, R.A.—We regret that we have no space for your articles. They will be returned to any address you may forward.

John A. R. Newlands, F.C.S.—Declined, with thanks. Such purely theoretical speculations occupy more space than we can now spare.

C. R. C. Tichborne.—Received, with thanks.

A Subscriber.—A work on the subject is in the press. It will be announced in these columns.

Analyst.—Chevreul's work, "On Fats," is very rare; it was published about the year 1828.

Alfred Bird.—Received, with thanks.

A Three Years' Subscriber.—You cannot make an extra strong boiled oil; but the older the oil before it is boiled the better for your purpose.

D. F.—A book treating, among other subjects, on Bleaching of Linen, by the Editor of this paper, is in the press, and will shortly be issued.

L. Nightingale.—Any good work on agricultural chemistry will give you the information you seek.

V. A. U.—The copyright will belong to the proprietor of the magazine, unless you stipulate for its reservation when sending the article.

H. H.—1. Some excellent lectures on coal-gas appeared some little time ago in the CHEMICAL NEWS: consult these. 2. Mulder on the "Chemistry of Beer."

James Wylde's courteous letter in reference to the *Electric Telegraph Review* is received, with thanks, and shall meet with due attention.

R. C. Moffat, Ph.D.—1. The index is issued with the present number. Its great length and the care required in its preparation have rendered the delay of a week necessary. 2. Browning and Co., Minories, or Horne and Thornthwaite, Newgate Street.

Books Received.—"The Chemistry of Silesian Sugar-Beets," by Dr. Augustus Voelcker. London: W. Clowes and Sons. "The Life and Letters of Faraday," with portrait and woodcuts, by Dr. Bence Jones, F.R.S., &c. London: Longmans and Co. "The Mechanic:" part 21, for December. "A Manual of Diet for the Invalid and Dyspeptic, with a Few Hints on Nursing," by Duncan Turner. London: John Churchill and Sons. "The Development of the Idea of Chemical Composition," by Alexander Crum Brown, M.D., D.Sc. Edinburgh: Edmonston and Douglas. "A Treatise on Asiatic Cholera," by C. Macnamara. London: Churchill.

AMERICAN SUPPLEMENT.

New York, February, 1870.

The Purification of Coal Gas, and the Gas Nuisance in New York.

Report of Prof. C. F. Chandler to the Metropolitan Board of Health, of New York.

Colonel Emmons Clark, Secretary of the Metropolitan Board of Health:—

Sir.—In answer to the resolution of the Board of Health, directing the chemist to make a statement *in extenso* of the methods of purification employed by the several gas companies of New York, I have the honor to submit the following report:—

I.—METHODS OF PURIFICATION IN GENERAL USE.

The crude gas which is produced by the exposure of bituminous coal to a bright red heat, in clay or iron retorts, is freed, during its passage through the hydraulic main, the condenser, and the washer, from the tar which it contains, and from a portion of its water and ammoniacal compounds. It still contains, however, objectionable impurities, which must be removed by a process of purification. These are sulphuretted hydrogen, sulphide of ammonium, cyanide of ammonium, sulphocyanide of ammonium, bisulphide of carbon, certain other sulphur compounds whose exact nature is not known, and carbonic acid. The sulphur compounds are all very objectionable; they give the gas a very offensive smell, and when burned, produce sulphurous acid, which, if produced in any considerable quantity, would quickly render the air of a room unfit for human life, and seriously injure furniture and goods exposed to its action. These sulphur compounds must therefore be removed. The carbonic acid gas is objectionable only in as far as it diminishes the illuminating power of the gas when present in appreciable quantities. There is no sanitary objection to carbonic acid; for perfectly purified gas would produce, when burned, a great many times as much carbonic acid as exists in the most impure crude gas. The presence of ammonia in gas in appreciable quantities is objectionable; but as all the methods of purification, at present used, remove the compounds of ammonia very effectually, we may confine the discussion to the sulphur compounds and the carbonic acid. There are four methods of purifying gas now in use.

1. *The Wet Lime Process.*

This process involves passing the gas through milk of lime. It is the oldest process in use, and is very effective in removing both the sulphur compounds and the carbonic acid. It has been generally abandoned, however, on account of the difficulty of disposing of the foul milk of lime, called "blue billy." Occurring as a liquid, the "blue billy" is not easily transported; and as it does not rapidly undergo oxidation, it is not well adapted for use as a fertilizer. Running it into rivers and streams has been forbidden by law, as the pollution of the waters by it was intolerable, while the extremely offensive smell which it emits makes it impossible to store it until it becomes dry enough for transportation.

2. *The Dry Lime Process.*

In this process dry or slightly moist hydrate of lime is placed on trays in iron boxes, through which the gas is made to pass. This process is very effective, and has very generally superseded the wet lime process. It removes the sulphur compounds and the carbonic acid equally well. When the foul lime is removed, however, it evolves the same odor which caused the wet lime process to be abandoned. When exposed to the air it rapidly undergoes oxidation, becoming heated in consequence. During this process it evolves sulphide of ammonium and some other compounds whose exact nature is not known, but whose odor is extremely offensive. This is the cause of the "gas nuisance" so loudly complained of a few years ago, when all the New York companies employed this process of purification. After the oxidation of the foul lime is completed it ceases to be specially offensive, the peculiar stench being evolved during the first hour or two of exposure. The offensiveness of this foul lime became such a constant cause of complaint in the large cities of Europe that the gas companies were compelled to abandon the process, as they had previously abandoned the wet lime. A system of ventilating the foul lime has been invented and is now in use at both the stations of the Manhattan Company in this city, which effects its oxidation in such a manner that the offensive gases evolved are not permitted to escape into the atmosphere, but are passed through a washing apparatus and finally through a special purifier, by which they are rendered comparatively inoffensive. This invention seems to obviate the nuisance of dry lime purification.

3. *The Laming Process.*

In 1849 Mr Laming introduced the hydrated sesquioxide of iron as a substitute for lime for purifying gas, preparing it of a suitable quality by mixing copperas (sulphate of iron) with slacked lime and sawdust, and exposing the mixture to the air to oxidize the protoxide of iron to the sesquioxide. The resulting mixture contains hydrated sesquioxide of iron, sulphate of lime, and sawdust.

When an excess of hydrate of lime is employed the resulting mixture contains this substance also. This material is very effective in removing the sulphur compounds from the gas. There is, however, some difference of opinion as to the completeness with which the carbonic acid is removed, due perhaps to variations in the proportions of the ingredients. Two important advantages attend the use of this mixture; first, when fouled it does not evolve offensive odors on exposure to the air; second, by exposure to air the sesquioxide of iron, which has been changed to sulphide of iron in the purifier, is regenerated, the sulphur being liberated and sesquioxide of iron again formed. The mixture may therefore be used again and again, till it becomes so clogged with the sulphur liberated that it does not act promptly on the gas. It is then found to contain from forty to sixty per cent of sulphur, and may be used for the manufacture of sulphuric acid. I have seen mixtures which had been in use twelve months.

4. *The Iron Ore Process.*

A few months after Laming introduced the artificial hydrated sesquioxide of iron in France, Mr. J. M. Hills applied the natural hydrated sesquioxide of iron, or "bog iron ore," in England. This material, like the Laming mixture, may be used again and again, and does not evolve offensive odors when exposed to the air. A modification of this process is now used by the

New York Gas Light Company of this city. It was invented by Messrs. St. John and Cartwright, and has been in use nearly two years, giving entire satisfaction. As the bog iron ores of this neighborhood are not sufficiently pulverulent to act promptly on the gas, Messrs. St. John and Cartwright add to the ore a quantity of iron borings or turnings, which they then convert into an artificial hydrated sesquioxide of iron by moistening the whole with ammoniacal liquor and exposing it to the air. The resulting mixture of natural and artificial oxide receives an addition of coarsely pulverized charcoal. This mixture is always sprinkled with ammoniacal water before it is placed in the purifier.

The material now in daily use at the works of the New York Gas Light Company was introduced in April, 1868. Occasional additions of iron borings have been made to it; otherwise the material is the same. When last tested it contained thirty per cent of sulphur. In Germany several varieties of sesquioxide of iron are now in use, prominent among which are "the Oberuseler mixture," an iron ore containing some oxide of manganese; the "Manheim oxide," and "Deicke's oxide," very pure artificial oxides of iron.

II.—EXTENT TO WHICH THE DIFFERENT METHODS OF PURIFICATION ARE EMPLOYED.

The wet lime method has been almost entirely abandoned. The only works at which I know it to be used at present are at Cork, in Ireland. These works are of moderate size, and are situated out of the city. Moreover, the gas is freed from ammonia by means of sulphuric acid, before it comes in contact with the lime. The foul lime does not, therefore, evolve sulphide of ammonium when exposed to the air. The dry lime process, though still in general use in this country, has been almost universally abandoned in Europe. Abandoned, firstly, because the foul lime was an intolerable nuisance; secondly, because the process is too expensive, as the lime can be used but once, and when exhausted has but a trifling value as a fertilizer.

The Laming mixture is now used in many of the European gas works. All the gas supplied to Paris is purified by this material. The German gas engineers have found that this mixture owes its efficacy entirely to the oxide of iron which it contains, and that the sulphate and hydrate of lime present do not take any appreciable part in the purification. Hence they are abandoning this mixture for the natural or artificial oxides of iron, which are cheaper and more efficient.

The iron ore method is now most generally used in Europe, and has obtained a foothold in this country, being used by the New York Gas Light Company in this city, as already described, and by two or three companies in Massachusetts. All the Liverpool gas, much, if not all, of the London gas, and that of most of the German cities, is now purified either by iron ore or one of the artificial oxides of iron. As my statements with regard to the general use of iron in place of lime were called in question during the hearing before the Board of Health, I will state that they were fully confirmed by my observations in Europe during the past summer, and will quote two or three unimpeachable authorities. Dr. Schilling, director of the gas works at Munich, and editor of the *Journal für Gasbeleuchtung*, says on page 247 of that journal for 1868: "Iron purification is now in general use." Mr. A. Buhe, who was one of the chemists employed by the German Gas Association to investigate the whole subject of gas purification, says, in the above mentioned journal for 1868, page 327 *et sequitur*: "Gas engineers have sought by various means, especially by lime, to remove the carbonic acid from gas; but these have been generally abandoned on account of the cost and the numerous disadvantages which attend their use." . . . . "Purification by lime is hardly in use at the present time." Mr. G. R. Hislop, engineer and manager of the Paisley Gas Works, and President of the North British Association of Gas Managers, stated in his address at Glasgow, July 28, 1869: "Purification by lime in London and elsewhere has now become inadmissible; in such places oxide of iron is employed as the purifying agent."—(*Journal of Gas Lighting*, 1869, p. 695.)

III.—COMPARATIVE ADVANTAGES OF THE DIFFERENT METHODS.

The lime methods effectually remove the carbonic acid, and reduce the sulphur compounds to a minimum. Were there no objections to the use of dry lime on the score of cost or offensiveness, I think this agent would be generally preferred. Lime was first abandoned on account of the nuisance which it occasioned, but the iron oxides are now actually preferred by the European gas engineers on account of their greater economy. Mr. King, the engineer of the Liverpool works, assured me that the oxide of iron purification, which he had used exclusively for the past seven or eight years, cost less than half as much as the dry lime process used previously.

Two objections are urged against the iron methods by those who are prejudiced in favor of lime. First, they do not remove carbonic acid; second, it is claimed that they do not remove the sulphur compounds as completely as lime.

The first is generally conceded to be true. But the only objection to carbonic acid is that it reduces the illuminating power of the gas. One per cent of carbonic acid diminishes the illuminating power five per cent. The average quantity of carbonic acid is, say two and one-half per cent—then the illuminating power of the gas will suffer to the extent of twelve and one-half per cent, or one-eighth.

There are two ways in which this difficulty can be effectually met: First, by using better coals for making the gas, or adding a few pounds of rich cannel or some other enriching material to the ordinary gas coals; or secondly, by taking less gas from the coal. The last gas drawn from the coal is always inferior to that which comes off first. Mr. A. Buhe, already referred to, says: "It has become more and more the custom to leave the carbonic acid in the gas, and to neutralize its bad influence on the illuminating power by taking less gas from the coal, thus getting a better gas." Dr. Schilling says: "Carbonic acid is of no consequence to the consumer; cannel coal is the remedy."

The second objection to the iron processes is the alleged imperfect removal of the sulphur compounds. None of the methods in use entirely remove the sulphur from the gas. The question arises, therefore, how much sulphur can be safely left in the gas. The English parliament has answered this question by fixing the limit at twenty grains of sulphur to 100 cubic feet of gas; and, to see that the companies come within this limit, chemists are appointed whose duty it is to analyze the gas and to report its quality. I have before me the report of Dr. Letheby for the months of January, February, and March, 1869. He states the grains of sulphur found in 100 cubic feet of gas to be as follows:-

	Maximum.	Minimum.	Average.
City of London Gaslight and Coke Company.....	18·92	11·70	15·00
The Gaslight and Coke Co....	24·15	15·75	19·49
Great Central Gas Consumers' Company.....	24·00	7·03	12·28

From this it will be seen that the gas of London, although purified by iron, does not average twenty grains of sulphur in 100 cubic feet. With regard to the Paris gas, which is purified by Laming's oxide of iron mixture, Professor J. Lawrence Smith, one of the United States Commissioners to the French Exposition of 1867, who is the president of the Louisville Gas Company, has given us a very decided opinion. On page 88 of his report, which was published by the United States government, he says: "The gas of these works is most thoroughly purified, and the dealers in silks and other delicate fabrics, who, a few years ago, always suffered more or less loss from the results of the combustion of impure gas acting on their fabrics, now no longer suffer from this cause."

Dr. Letheby (*Journal of Gas Lighting*, 1869, page 83) has argued that twenty grains of sulphur should not be left in the gas, and proposes, therefore, as the most effective method of purifying gas, this treatment: first with ammoniacal liquor; second, with hydrated oxide of iron; third, with dry lime. As the iron will have removed the sulphuretted hydrogen, the refuse lime will not be offensive, while it will effectually remove the carbonic acid. This system of purification will, he thinks, reduce the quantity of sulphur to ten or twelve grains per 100 cubic feet. Most gas engineers and chemists differ from Dr. Letheby on this point, however. Dr. Schilling says in his *Journal für Gas Beleuchtung* for 1869, page 484: "Twenty grains of sulphur in 100 cubic feet of gas are entirely unobjectionable. Under the most favorable circumstances, with no ventilation whatever, it would give the atmosphere of a room only one part of sulphurous acid in 500,000 parts of air." Professor William Odling, secretary of the London Chemical Society, has spoken very clearly on this subject in his lecture to the British Association of Gas Managers, June 2, 1868, which appears in the *Journal of Gas Lighting* for 1869, page 81, and I have found that his views are those generally entertained by chemists and gas engineers. He said:—

"I am altogether at issue with the public when they maintain that the sulphur of gas produces, by its combustion, oil of vitriol, or that the amount of sulphur ordinarily contained in gas is of any consequence whatever; and a little consideration will, I think, satisfy you of the soundness of this position. We will assume that coal gas contains not twenty, but forty grains of sulphur in 100 feet, a quantity, at any rate, greatly exceeding the reality. Now, making another extravagant assumption that the whole of these forty grains of sulphur would be completely burned—and, in reality, they would be burned very incompletely—they would furnish, by their combustion, eighty grains of sulphurous acid gas. This quantity of the produced sulphurous acid would occupy at ordinary temperatures about one-fifteenth part of a cubic foot, and since 100 cubic foot of our coal gas gives one-fifteenth of a cubic foot of sulphurous acid, 1,500 cubic foot of coal gas would be required to furnish one cubic foot of the acid, even upon the extravagant assumptions we have purposely made. But the combustion of 1,500 feet of coal gas would produce something besides sulphurous acid. It would produce at least 1,000 cubic feet of carbonic acid, and, in addition to its dilution by other gases and vapors, we should have our sulphurous acid diluted by 1,000 times its volume of carbonic acid. Now, if we can get at the proportion of carbonic acid in the atmosphere of a room highly illuminated with gas, and take the thousandth part of that proportion, we shall be able to form some notion of the amount of sulphurous acid present. You will remember that the amount of carbonate acid furnished by the breath of one individual is equal to that furnished by two three-feet gas burners, and that the maximum amount of carbonic acid found in the atmosphere of a crowded theatre was 0·32 per cent. Now, if in addition to our previous unreasonable suppositions we further suppose that an atmosphere contains 0·2 per cent. of carbonic acid furnished by gas combustion, you will see that the whole matter becomes a *reductio ad absurdum*—that we might actually have one-half millionth part of sulphurous acid present in the air of a gas-lighted room."

I think that the facts and opinions here quoted effectually dispose of the second objection to oxide of iron purification. It may seem that I have said more than was necessary on the comparative merits of the lime and iron processes of purification, but a perusal of the testimony given during the hearing before the Board will recall the fact that the evidence of the experts, called by the Metropolitan Gaslight Company, was almost entirely confined to this question. In fact, the defence offered was the alleged total failure of the iron processes, and the consequent unavoidable use of lime.

(To be concluded in the next number.)

The Various Methods for the Determination and Separation of Baryta, Strontia, and Lime. Also some Remarks on the Precipitation of Sulphuric Acid by Salts of Baryta.

By Paul Schweitzer, Ph.D.

I.—*Determination of Baryta.*

Baryta may be precipitated from its solutions in either of the following forms; viz., as sulphate, chromate, or carbonate of baryta or silico-fluoride of barium. The sulphate is generally considered as giving the most accurate results, and the others are seldom employed except in special cases. There are precautions to be observed in the precipitation of the alkaline earths, the neglect of which will lead to more or less inaccurate results, on account of their precipitates, and particularly their sulphates, carrying and retaining alkaline salts with so strong an affinity as to require a special treatment to free them entirely from the same. The amount of alkali retained in this way varies somewhat, according to the treatment of the precipitate in question; and although in ordinary determinations of alkaline earths the results are not much affected, the error, in more accurate researches, and in the determination of sulphuric acid by a salt of baryta, will be large enough to cause material inaccuracy and inconvenience.

Sulphate of Baryta.

For the determinations of baryta, pure crystallized chloride of barium was used, which had been heated for some time at a strong red heat. It loses its water with difficulty, and, with the last traces of it, some hydrochloric acid. It should be then mixed with dry chloride of ammonium, and so[illegible] until all ammoniacal salts are volatil[illegible]ith, previous addi[illegible]solve to a clear

solution in water. For the three following determinations this anhydrous chloride of barium was dissolved in water, and the solution precipitated with a slight excess of dilute sulphuric acid—A in the cold, B in the cold after acidulating with hydrochloric acid, and C boiling hot after acidulating with hydrochloric acid in the same way. The supernatant liquid in C, after standing, was decanted, and the precipitate boiled with dilute hydrochloric acid and water; after decanting a second time this boiling was repeated, and all three precipitates brought then upon their respective filters, and washed—A and B with cold, and C with hot water. C was washed out first, next B, and lastly A. No hydrochloric acid could be detected in the last filtrates.

	A.	B.	C.
BaCl used.....	1·8230 grms.	1·4716	2·2560
BaO,SO_3, found.	2·0375 grms.	1·6470	2·5210
BaCl calculated from last....	1·8260 grms.	1·4697	2·2496
BaCl.....	100·16 p.c.	99·87 p.c.	99·71 p.c.
	+0·16 p.c.	−0·13 p.c.	−0·29 p.c.

The sulphate of baryta will best subside when precipitated from a hot solution, and can then be washed very easily. If it is, however, precipitated in the cold, it requires some time, often 24 hours, before it has completely separated and settled. This fact must especially be borne in mind, when very small amounts of baryta have to be separated from large quantities of other salts, as is the case in the analysis of some mineral waters, iron ores, etc. The same precautions must be observed in the precipitation of sulphuric acid by means of a salt of baryta. It would appear as though there was at first formed an amorphous sulphate of baryta, which, like the carbonates of the alkaline earths, when precipitated from concentrated solutions is hydrous and somewhat soluble in water, and becomes insoluble, heavy, and crystalline only by losing its water.

The results of the above determinations are satisfactory, yet the solution should not contain too much free acid, as in that case, upon the repeated treatment, more than a mere trace of the precipitate will be dissolved. When, however, baryta is to be precipitated from a solution containing alkaline salts, a more or less considerable amount of the salts will always be carried down with the sulphate of baryta, and which under no conditions can be washed out from it. Where there are only trifling amounts of alkaline salts in a solution, large dilution with acidulated water before precipitation may answer; the error, however, will amount to about 1 p.c. of the calculated chloride of barium present, and will be greater when small quantities of baryta or sulphuric acid have to be determined in this way. The removal of the retained alkalies in such cases can only be effected by dissolving the precipitate of sulphate of baryta in concentrated sulphuric acid, which can easily be accomplished in a platinum dish with the application of heat, and precipitating again with water. Sulphuric acid in such cases takes the place of the alkaline salt. In fact sulphuric acid adheres to the sulphate of baryta always, even when the filter has not been carbonized by not washing completely, and can be easily detected upon igniting a dried precipitate of sulphate of baryta. Boiling with hydrochloric acid, as has been proposed, is unavailing, as can be seen by comparing Analysis C with A, B and B_2.

For the follo[illegible]ed by the Ger[illegible]s the chloride of the whole subject of b[illegible]

barium was dissolved in water, and mixed in each case with 3 grms KCl and 3 grms. NaCl, and the solution precipitated with a slight excess of dilute sulphuric acid—A in the cold, B_1 and B_2 in the cold after acidulating with hydrochloric acid, and C boiling hot after acidulating in the same way. The precipitated sulphate of baryta in C was boiled twice with dilute hydrochloric acid and water, as described before, and all four precipitates then brought upon filters and washed, A, B_1 and B_2 with cold, C with hot water, until no hydrochloric acid could be detected in the filtrates, and a large quantity of the wash-waters left no residue upon evaporation.

The amount of fluid in B_1 was 330 c.c, of wash-water 430 c.c.; the amount of fluid in B_2 was 1730 c.c., of wash-water 190 c.c. In all four precipitates soda as well as potassa could be detected by the spectroscope.

A.	B_1.
BaCl.....2·0875	1·4860
BaO,SO_3.....2·3795	1·6840
BaCl.....2·1234	1·5027
101·72 p.c.	101·12 p.c.
+1·72 p.c.	+1·12 p.c.

B_2.	C.
BaCl.....+1·3934	2·2655
BaO,SO_3.....1·5780	2·5650
BaCl.....1·4081	2·2880
101·05 p.c.	101·03 p.c.
+1·05 p.c.	+1·03 p.c.

Long continued washing with or without addition of hydrochloric acid does not, therefore, remove the alkalies from the precipitated sulphate of baryta, and the only way which was found effectual for this purpose was to dissolve it in concentrated sulphuric acid. The sulphate of baryta, thus treated, washed, and ignited, will hardly show any traces of alkalies before the spectroscope, and represents the exact amount of baryta salt present.

Of the sulphate of baryta of B_1, 1·6730 grms. were treated in the manner above described. As it contained 1·12 p.c. of alkalies, they correspond to

1·6543 grms. BaO,SO_3 (0·0187 gr. alkalies).
1·4762 " BaCl.

The sulphate of baryta, precipitated from its solution in concentrated sulphuric acid, amounted to

1·6530 gr. BaO,SO_3
1·4751 gr. BaCl
99·93 p.c.
−0·07 p.c.

Determination of Sulphuric Acid.—In order to determine the character of the affinity of sulphate of baryta for alkaline salts, some experiments were made in an opposite direction by precipitating sulphate of soda and potassa with an excess of chloride of barium. By thoroughly washing the precipitates of sulphate of baryta obtained in this way, either with (A.) or without (B.) the addition of hydrochloric acid, the excess of chloride of barium is first washed out, together with the chlorides of the alkalies present. By continuing the washing longer, sulphuric acid appears in the filtrate (to be detected by chloride of barium), which requires much water and a long time to remove completely. The appearance of sulphuric acid in this place is owing to a decomposition of a compound of sul-

phate of baryta with the sulphate of an alkali. It is apparent, therefore, that in such a case the source of error may be twofold; firstly, by losing sulphuric acid in the way indicated, and by retaining sulphuric acid in the form of a sulphate of an alkali. These two errors apparently compensate each other sufficiently for practical purposes. Scientific investigation must, however, as much avoid the one as the other.

A	B
3·2133 gr. NaO,SO_3	4·1824 KO,SO_3
5·2735 BaO,SO_3	5·5580 BaO,SO_3
3·2139 NaO,SO_3	4·1559 KO,SO_3
100·02 p.c.	99·36 p.c.
+0·02 p.c.	−0·64 p.c.

A very large amount of water was necessary in these two analyses, to remove the alkali. But, after igniting the precipitates, soda as well as potassa could be detected in them by the spectroscope. The wash-waters, therefore, should be preserved, and any precipitate which may have formed by long standing be filtered out. Both precipitates of sulphate of baryta should then be dissolved in concentrated sulphuric acid, and, after again precipitating, weighed. The wash-waters may be evaporated for the determination of alkali, if necessary.

If the amount of alkali retained by sulphate of baryta be about 1·12 p.c. of the weight of the chloride, we will have lost in A 1·10 p.c. and in B 1·76 p.c., showing that more of the sulphate of potassa is retained as such than of the sulphate of soda; and by long washing and decomposing such a compound we lose, of course, more of the former than of the latter.

All the precipitates of baryta which are produced by an excess of sulphuric acid must be washed completely, otherwise the filter paper will be charred on drying, on account of a small quantity of sulphuric acid which is retained, as has been previously stated.

Chromate of Baryta.

The chloride of barium used for the following determinations was dissolved in water, and precipitated, in A, with a solution of chromate of ammonia, in B with a solution of chromate of potassa, with the addition of a little ammonia to render the solution alkaline. This method will give good results, but is notwithstanding, almost impracticable, on account of the difficulty of obtaining chromates that are free from sulphuric acid. A previous partial precipitation with a salt of baryta will, however, remove all sulphuric acid, yet the principle must necessarily be objectionable in a strictly scientific point of view. This method is, therefore, only practicable for the determination of chromic acid, which in small quantities in certain ores can be very accurately estimated in this way. The chromate of baryta will hold alkalies, if there are any in solution, but much less so than the sulphate.

The precipitates, after standing for 24 hours, were filtered on a weighed filter and washed with cold water, until no hydrochloric acid could be detected in the filtrate. The wash-waters showed a trace of baryta with dilute sulphuric acid, after standing for some time.

A	B
2·0020 BaCl	1·3960 BaCl
2·4435 BaO,CrO_3	1·7090 BaO,CrO_3
2·0040 BaCl	1·4020 BaCl
100·10 p.c.	100·43 p.c.
+0·10 p.c.	+0·43 p.c.

Carbonate of Baryta.

The chloride of barium was dissolved in water, and, with the usual precautions, precipitated with carbonate of ammonia, to which some free ammonia had been added. A and D were precipitated in the cold and washed with cold water. B and C were precipitated hot and washed with hot water. 3 grms. of KCl and 3 grms. of NaCl were respectively added to B, C, and D before precipitation. The washing was continued until no traces of hydrochloric acid could be detected in the filtrates. All the precipitates were amorphous and heavy, at first separating in the form of hydrates, but losing the water gradually by washing. The wash-water from A showed traces of baryta after standing twenty-four hours. The hydrous condition of these, and in fact of all the precipitates of baryta, is always an indication of their retaining alkaline salts. The amount of alkali retained by the carbonate of baryta, though at first very much larger than the amount retained by the sulphate, can be greatly reduced by long continued washing.

A	B
1·8705 BaCl	1·0055 BaCl
1·7705 BaO,CO_2	0·9573 BaO,CO_2
1·8685 BaCl	1·0104 BaCl
99·89 p.c.	+100·49 p.c.
− 0·11 p.c.	+0·40 p.c.

C	D
1·8435 BaCl	1·8035 BaCl
1·7566 BaO,CO_2	1·7205 BaO,CO_2
1·8540 BaCl	1·8159 BaCl
100·57 p.c.	100·69 p.c.
+0·57 p.c.	+0·69 p.c.

Silicofluoride of Barium.

This method can only be used in special cases, as most of the salts of the alkalies and alkaline earths are insoluble, or very sparingly soluble in alcohol, and those that are soluble act as solvents for the silicofluoride of barium.

The neutral, or slightly acid solution of the baryta salt is mixed with pure hydrofluosilicic acid and about the same volume of alcohol. After standing for about twelve hours, the precipitate is filtered on a weighed filter, washed with a mixture of equal parts of alcohol and water, until the reaction ceases to be acid (this would not be sufficient when alkalies are present), and dried 100° C.

Only one analysis was made—the insolubility of the alkalies in alcohol, preventing an investigation of the affinity of the silicofluoride of barium for their salts.

1·8205 BaCl
2·4500 BaF,SiF_2
1·8169 BaCl

99·75 p.c.
— 0·25 p.c.

Oxalate of Baryta.

In order to determine whether oxalate of baryta likewise contained alkaline salts, if precipitated under similar conditions, some experiments were made with this salt. With this design, chloride of barium, dissolved in water, was precipitated with oxalate of ammonia, with the addition of some free ammonia. A, without, B and C with, previous addition of 3 grms. KCl

and 3 grms. NaCl. The baryta precipitate is more soluble than the corresponding lime salt, and as crystalline as the latter, if precipitated from dilute solutions, where it will form only after some time, quicker after heating; but voluminous when precipitated from concentrated solutions. The washing was continued until all hydrochloric acid had been removed, the wash-waters then containing much baryta.

A	B	C
1·6965 BaCl	1·9695	1·7135
1·5700 BaO,CO_2	1·8340	1·5967
1·6670 BaCl	1·9356	1·6852
97·68 p.c.	98·28 p.c.	98·35 p.c.
— 2.32 p.c.	— 1·72 p.c.	— 1·65 p.c.

I find it in these cases better to weigh as carbonate than caustic baryta, a longer and higher heat being required to expel carbonic acid from baryta than from lime.

By comparing these analyses, it will be seen that about one-half per cent of alkali will be retained by the oxalate. But I do not doubt that the oxalate, as well as the carbonate of baryta, can be freed entirely from the alkaline salts by washing; probably owing to their condition, in which state the compound of alkaline earth with alkali can be easier acted upon by the wash-water.

(To be concluded in our next number.)

Dangerous Kerosene.

We continue to record the casualties which result from the sale and use of dangerous kerosene, in the hope that, by warning the public against all the products of petroleum which are unsafe, we shall contribute to drive them from the market entirely.

In New York, the North-German brig *Der Fleiss*, which was anchored opposite Quarantine landing, blew up, and burned to the water's edge. She was loaded with a cargo of naphtha, and bound to Spain. The captain, mate, and cabin-boy were considerably burned, but saved themselves, with the rest of the crew, by jumping overboard.

On the evening of December 10th, Margaret Gallagher was fatally burned by the explosion of a can of "Union oil," at 117 Charles street. She survived only twenty-four hours. The coroner's jury rendered a verdict censuring Mr. Rappelye for selling the oil—rather mild punishment for his part in the kerosene murder. He promised not to sell any more of the dangerous compound.

At the corner of Av. A and 19th street a barrel of kerosene was ignited by the upsetting of a lamp, setting the house on fire, and causing some damage.

Francisco Berryman, aged 21 years, died December 23d, at 53 Eldridge street, from burns occasioned by the explosion of a kerosene lamp.

On the evening of December 23d, a fire broke out at 336 Columbia street, caused by the spilling of a villanous burning fluid called "new gas." It took fire from a candle, blazing up in the face of the woman who held it. The building was damaged to the extent of $1,500; the next house, $1,000.

In Jersey City, Mrs. Emma Sandburger was engaged in filling a lamp, when some of the explosive fluid dropped upon the stove and ignited. The flames communicated to the can containing the liquid, and this exploded. She was fatally burned, and her daughter, in endeavoring to smother the flames, was badly burned.

On December 14th an explosion of naphtha occurred in Boston, severely injuring U. S. Drake, manufacturer of portable gas machines, and slightly injuring several of his workmen.

A disastrous fire broke out at Jackson, Mich., on the evening of December 31st. It originated from an attempt to draw gasolene near a lamp. Loss estimated at $200,000.

Fire Marshal Brackett reports 31 of the 311 fires which occurred in Brooklyn last year, or 10 per cent., to have been caused by kerosene. The number in New York was 98 in 913, or a little more than 10 per cent.

Gen. Alexander Shaler, President of the Metropolitan Fire Department, says, in a letter to the *New York Times:* "Among the thousand and one causes of fire in our city, the use of inferior kerosene oil is probably the most frequent, and seems likely to remain so until another equally economical, but less dangerous article is furnished for the use of the masses, or a law enacted and enforced which shall hedge it around with such safeguards as will secure immunity from accidents. But I apprehend no law can be enforced which will make careless persons careful. The only way, therefore, to reduce the chances of fires from the use of inflammable oils, is to convince the dealer that 'honesty is the best policy,' and the most profitable one for him to pursue, by inflicting severe penalties for exposing for sale an article that vaporizes below 100° Fahrenheit. The Commissioners have done and are now doing everything in their power to prevent the sale of oils which do not come up to the standard required by law. But the law is found to be defective in its operation; and it is hoped that the incoming Legislature, upon having their attention called to it, will make such enactments as will render the use of inflammable oils comparatively safe."

The *New York Times* protests against the transportation into the heart of the city of car loads of crude petroleum.

On December 8th, Dr. Harris, the Sanitary Superintendent, reported to the Board of Health the results of the kerosene examinations for the previous two weeks. Of 40 samples examined, not one came up to the standard of safety required by law, viz.: *Flashing point*, 100° *F.*; *burning point*, 110° *F.*

The City Court has decided all the kerosene cases against the Board of Health; so dealers may sell liquid gas and dangerous kerosene, and murder housemaids and children with impunity—at least till the case can be carried up to a higher tribunal, which will be done as soon as possible.

Recent Chemical Patents.

Issued November 23, 1869.

97,059.—Apparatus for obtaining Extractive Matters from Sugar-Cane, and other Materials.—L. A. de Lime, St. Louis, Mo.

97,143.—Process of Brewing Beer.—C. Abresch, New York.

97,145.—Curing and Preserving Fish.—R. A. Adams, Cambridge, Mass.

97,182.—Mode of Recovering the Spent Acid from Oil-Refineries.—L. S. Forbes, New York.

97,220.—Manufacture of Soap.—N. Orcutt, Syracuse, N.Y.

97,262.—Lubricating Compound.—C. S. Moore, Erie, Pa.

Issued November 30, 1869.

97,365.—Mode of Producing White Lead.—J. G. Dale and E. Milner, Warrington, England.

97,417.—Metallic Solution for Coating Iron and Steel.—A. A. Lothrop, Neponset, Mass.

97,454.—Dissolving Xylodine for Use in the Arts.—D. Spill, Hackney, England.

97,457.—Apparatus for Generating and Carburetting Illuminating Gas.—A. Stevens, Fitchburg, Mass.

97,469.—Compound for Disinfecting and Deodorizing.—H. G. Dayton, Dayton, Ohio.

Issued December 7, 1869.

97,486.—Compound for Lining Textile Hose.—J. Dollmann and F. W. Claessens, Boston, Mass.

97,497.—Process of Dyeing Black.—J. Gee, West New Brighton, N.Y.

97,528.—Mode of Preparing Paper for Printing Postage and Revenue Stamps.—S. Lenher and H. H. Spencer, Philadelphia, Pa.

97,566.—Explosive Compound for Use in Fire-Arms, Blasting, etc.—T. Taylor, Washington, D.C.

97,567.—Gunpowder —T. Taylor, Washington, D.C.

97,580.—Generating Hydrogen and Hydrocarbon Gas.—J. S. Wood, Philadelphia, Pa.

97,582.—Manufacture of Steel.—J. Amsterdam, New York.

97,597.—Process of Treating Asphaltum to Obtain Colors and Dyes.—J. Bronner and H. Gutzkow, Frankfort-on-the-Maine, Prussia.

97,607.—Process for Decorative Oil-Painting.—P. Cousin and P. Oury, Paris, France.

97,632.—Mode of Generating Illuminating Gas.—A. Hamar, Philadelphia, Pa.

97,657.—Mode of Preventing Corrosion in Pipes, Bolts, and Similar Articles of Iron in Sea-Water.—R. Lighthall, Brooklyn, N. Y.

96,692.—Manufacture of Soap.— W. P. Pugh, High Point, N.C.

97,718.—Manufacture of Iron and Steel.—H. Spencer and L. K. Taylor, Philadelphia, Pa.

Issued December 14, 1869.

97,754.—Mode of Treating Conglomerates of Cast-Iron.—T. Blair, Pittsburg, Pa.

97,761.—Reducing Ores.—T. J. Chubb, Williamsburg, N.Y.

97,771.—Manufacture of Glue.—G. Guenther, Chicago, Ill.

97,838.—Silvering Glass, and Protecting the Same.—H. B. Walker, New York.

97,844.—Apparatus for Purifying Iron.—S. M. Wickersham, Alleghany, Pa.

97,880.—Manufacture of Rubber Sponge.—E. Chesterman, Tremont, N.Y.

97,889.—Treating Whiskey and Other Alcoholic Spirits.—J. C. Crosman and O. Marland, Boston, Mass.

97,897.—Manufacture of Iron and Steel.—W. Ennis, Philadelphia, Pa.

97,936.—Manufacture of Dry White Lead.—G. T. Lewis, Philadelphia, and E. O. Bartlett, Birmingham, Pa.

97,939.—Fertilizer or Guano.—O. Lugo, Baltimore, Md.

97,941.—Manufacture of Ultramarine.—H. A. Ludwig, New York.

97,949.—Galvanic Battery.—J. R. McPherson, Beloit, Wis.

97,972.—Composition Metal for Tubing, Pipes, and Sheeting.—W. A. Shaw, New York.

97,983.—Water-Proofing Fabrics.—J. Stenhouse, London, England.

Reissues.

90,549, reissue 3,742.—Apparatus for Drying Sugar and other like Articles.—G. A. Jasper, Charlestown, Mass.

90,644, reissue 3,748.—Apparatus for Generating and Carburetting Gas.—C. F. Dunderdale, New York.

94,805, reissue 3,752.—Composition of Liquids for Tanning.—J. Wood, Woodstock, Vt.

Issued December 21, 1869.

98,046.—Vaporizing Petroleum, &c.—H. R. Foote, Boston, Mass.

98,110 —Electro-Plating with Brass and Other Alloys.—S. Rust, Jr., Cincinnati, Ohio.

98,118.—Gas Generator and Carburetter.—A. Stevens, Fitchburg, Mass.

98,139.—Apparatus for the Manufacture of Iron and Steel.—C. Adams, Philadelphia, Pa.

98,155.—Process of Treating Wines, Beer, and Liquors.—J. O. Donner, Jersey City, N. J.

98,165.—Process of Purifying and Decolorizing Albumen from Blood.—P. Jacques, Paris, France.

98,173.—Composition for Preventing Incrustation in Steam-Boilers. G. W. Lord, Philadelphia, Pa.

98,210.—Manufacture of Paper-Pulp from Wood.—G. Vining, Pittsfield, Mass.

Issued December 28, 1869.

98,285.—Apparatus for Bleaching and Defecating Cane-Juice.—J. C. Marsh, Alexandria, La.

98,336.—Enamelling Iron and Steel.—B. Baugh, Chadwick, England.

98,343.—Apparatus for Filtering Volatile Liquids.—W. Boyce, Tuscola, Ill.

98,354.—Plating Iron for the Manufacture of Hinges, &c.—J. J. Crooke, Southfield, and Lewis Crooke, New York, N. Y.

98,364.—Manufacture of Sheet-Iron.—W. Fields, Wilmington, Del.

98,382.—Nitro-Glycerine Compound for Blasting.—J. Horsley, Cheltenham, England.

98,387.—Bleaching Cotton and Woollen Fabrics.—J. Jeaning, Plainville, Conn.

98,425.—Manufacture of Nitro-Glycerine.—T. P. Shaffner, Louisville, Ky.

98,426.—Process of Preserving Nitroleum and Other Explosive Liquids,—T. P. Shaffner, Louisville, Ky.

98,427.—Explosive Compound.—T. P. Shaffner, Louisville, Ky.

98,428.—Blasting Fuse.—T. P. Shaffner, Louisville, Ky.

98,442.—Apparatus for Producing and Carburetting Hydrogen Gas.—J. H. Steiner, Philadelphia, Pa.

Reissues.

88,208, reissue 3,775.—Manufacture of Iron and Steel.—J. Ralston A. L. Thomas, and W. Parkinson, Philadelphia, Pa.

77,304, reissue 3,777.—Preparing Compounds Containing Collodion.—J. A. McClelland, Louisville, Ky.

77,304, reissue 3,778.—Material for Turning Dental Plates.—J. A. McClelland, Louisville, Ky.

73,900, reissue 3,779.—Carburetting Air for the Production of Light and Heat.—B. Pilkington, Oakland, Cal.

NEW PUBLICATIONS.

Across America and Asia. Notes of a Five Years' Journey Around the World, and a Residence in Arizona, Japan, and China. By Raphael Pumpelly, Professor of Mining at Harvard University, and some time Mining Engineer in the service of the Chinese and Japanese Governments. Large octavo, 454 pp. New York, 1870.

Prof. Pumpelly has already recorded his scientific observations in a volume of "Geological Researches in China, Mongolia, and Japan," published by the Smithsonian Institution. The book before us is a narrative of the author's journey around the world in the Northern temperate zone. It consists of a series of sketches of the countries and the people visited, is illustrated by engravings and maps, and is full of incident and adventure. It is altogether a very interesting book, and its appearance at this time is specially opportune, when those Eastern nations seem just ready to shake hands with us across the Pacific; and are, perhaps, destined to play a very important part in the development of the nation which is springing up at the further end of the Pacific Railroad.

The Manufacturer's Review and Industrial Record. Edited by Isidor Walz, Ph.D., New York.

This is a very well conducted monthly journal, devoted to textile interests; dyeing, calico printing, etc. The editor is an accomplished chemist, and cannot fail to contribute much valuable instruction to his readers who are specially interested in the subjects to which the paper is devoted. We hail the appearance of every new technical journal published in this country as a new indication that manufacturers are learning to appreciate scientific instruction. The truth is, they are learning that they cannot keep pace with their competitors, except by invoking all the aid that science can afford.

We notice an increasing demand for chemists to take positions in manufactories, print-works, iron-works, sugar refineries, etc. We are moving in the right direction, and shall be ready for free trade one of these days.

Chloroform; and a New Method of Administering It. By A. M. Rosebrugh, M.D., Surgeon to the Toronto Charitable Eye Dispensary. New York: Wm. Wood & Co., 61 Walker st.

This is a handy little pamphlet of 31 pages, containing directions for testing the purity of chloroform; also giving its well-authenticated therapeutical properties, with statistics of deaths caused by its incautious use; the signs of danger are pointed out, together with the most approved means of resuscitation; and finally the author gives a new method of administering this anæsthetic.

Mr. Edward C. H. Day, of the School of Mines of Columbia College, contributes an excellent article to the American Educational Monthly for January, on *Minerals, Plants, and Animals, as objects of Popular Education*. Mr. Day has been very successful in his lectures on Natural History to the New York teachers, and has awakened a great interest in the study of Nature.

On the Simultaneous Occurrence of a Soluble Lead Salt and Free Sulphuric Acid in Sherry Wine; with Observations on the Solvent Action of Alcoholic Saline Solutions upon Sulphate of Lead. By Prof. Frank H. Storer, Professor of Chemistry in the Technological Institute at Boston; a paper read before the American Academy of Arts and Sciences, Oct. 13, 1868. 7 pp.

An account of some interesting and important observations and experiments on the action of acetates, tartrates, citrates, oxalates, succinates, and sugar upon sulphate of lead.

The American Grocer. A semi-monthly journal, published by John Darby & Co., New York.

It contains much valuable information with regard to almost every variety of food and drink.

Die Chemisch-technischen Mittheilungen des Jahres 1868-'69, Von Dr. L. Elsner. Berlin, 1870. A very valuable contribution to technical literature. B. Westermann & Co., 471 Broadway, New York.

Bibliotheca Historico-Naturalis, Physico-Chemica et Mathematica. A classified catalogue of all books on Natural History, Chemistry and Mathematics, published in 1869, from Jan. to June. B. Westermann & Co., 471 Broadway.

Bibliotheca Mechanico-Technologica et Œconomica. A classified catalogue of all books on technical chemistry, etc., published in 1869, from Jan. to June. B. Westermann & Co., 471 Broadway.

On the Magnetite in the Mica of Pennsbury, Pa.: in reply to Prof. G. Rose. By James D. Dana and George J. Brush. Extract from the *American Journal of Science and Arts* for Nov.

Prof. G. Rose considers the dendritic markings in the Pennsbury mica to be due to *hematite*, while Profs. Dana and Brush have pronounced them to be *magnetite*. The weight of evidence is decidedly on the side of magnetite.

BREVITIES.

Report of the Commissioner of Mining Statistics.—Mr. R. W. Raymond, Commissioner of Mining Statistics, has prepared a summary of his annual report. His principal work during the past six months has been the collection of information regarding new enterprises, and the condition and prospects of the industry in the different districts, and statistics of production. The principal mining and commercial centres of Colorado, Utah, Nevada, California, Oregon, and Idaho have been visited, and operations therein carefully noted.

The Commissioner reports that the product in California for the year will certainly fall below that of last year, on account of the extraordinary drought which put an end to the placer and hydraulic mining of the northern counties very early in the season. Another temporary cause of decreased production was the stoppage of several important mines in the foremost quartz-mining district of the State—Grass Valley—on account of a miners' strike. In Nevada the yield of the Comstock mines has been largely reduced this year by the exhaustion of various old workings upon which some of the companies have been relying, but especially by the disastrous fire in the Crown Point, Kentuck, and Yellow Jacket, which has interfered with the production of those important mines. The prospects of this district for the future, however, are considerably brighter than they were a year ago.

This year's product of bullion from Nevada will probably not fall far behind that of 1868, the deficiency from Washoe being made up by the greater yield of White Pine. On the whole the prospects of the State have improved, especially in view of the late discoveries in depth on the Comstock lode, the completion of the Pacific Railroad, and the gradual introduction of cheaper labor, particularly of Chinese, into the mines.

In Oregon the product of gold during the past season has been unusually small, since very little quartz mining is now carried on in the State, and the placer and hydraulic mines have stood still nearly all summer for the lack of water.

In Idaho the same causes which have affected the placer mines of Oregon, will render this year's product of gold comparatively small; but the results of quartz mining in the Owyhee and other districts will probably not fall short of last year. The drought has also extended into Montana, and a decrease in the yield from the hitherto so productive gulches is anticipated.

The Commissioner is of the opinion that Colorado is destined to advance henceforth with great rapidity toward wealth and power. The yield of the mines for 1869 is highly encouraging in view of the fact that it is the product of steady industry, and not the first fruits of a speculative activity, which might be expected to die out at an early day.—*N. Y. Evening Post.*

Nitroglycerine.—The Giant Powder Mills, situated in the suburbs of San Francisco, exploded on the evening of Nov. 26th. The building was blown to pieces, the glass in the neighboring houses was shattered, and the explosion was felt for a great distance. Dr. Cusemaus, the chemist and superintendent, was instantly killed. Two other white men were killed, and eight Chinamen were injured. The cause of the disaster is unknown. A considerable quantity of nitroglycerine was stored in the building. Giant powder is a mixture of nitroglycerine and infusorial silica.

An Explosion of Nitroglycerine occurred at the Hoosac Tunnel, on Saturday, Oct. 9th, by which three men were killed. The building in which the dangerous compound was stored was destroyed. On Monday night, Dec. 13th, during the ten o'clock shift of workmen at the Hoosac Tunnel, one of them spilled some nitroglycerine on the rocks, and, while removing the fragments after a blast, an explosion occurred, killing one man and severely injuring three more.

At Titusville, Pa., on December 16, a tremendous shock was caused by an explosion of the magazine of the Roberts' Torpedo Company, containing half a ton of nitroglycerine. The cause of the explosion is unknown. P. H. Brophy, the agent, and another man, who was near the magazine at the time of the explosion, were instantly killed. Considerable damage was done to the buildings throughout the city. The magazine was situated a mile from the city.

Lyceum of Natural History.—At the monthly meeting of the Chemical Section of the Lyceum of Natural History, on Monday evening, November 8th, President Newberry in the chair, several papers were introduced, the first of which, "On Hydrogenium," by Mr. A. B. Gallatin, deserves special mention, as it gave a synopsis of the last great effort of the dying Graham to establish the metallic nature of hydrogen. Several distinguished chemists had already turned their attention in the same direction, and Faraday's apparatus may still be seen at the Royal Institution of Great Britain. No one, however, had succeeded in proving experimentally the truth of the general supposition as to the nature of hydrogen. It was clear to Graham's mind that active hydrogen alone (that is, hydrogen in the nascent state) could be made to combine with other metals; and that, by decomposing an alloy thus obtained, the nascent state of the hydrogen while in the act of leaving the other metal would decide the long-pending question. Nascent hydrogen would prove that it came from a true chemical compound, and, in the case of a metal, from a true alloy; and, consequently, that it possessed the properties of a metallic element. The decomposition of water by means of an electric battery was most naturally employed as a source of nascent hydrogen, and by placing at the electro-negative pole various metals as electrodes, the conditions were most favorable to the success of the experiment. It was, however, by employing palladium that the expected result was obtained, that metal occluding, as it were, the hydrogen, and absorbing it to such an extent that none escaped until the palladium was completely saturated with it. The experiments proved that palladium takes up 936 volumes of hydrogen, and expands 4·908 per cent., or sixteen times as much as when heated from 0° to 100° C. By this wonderful property palladium is widely separated from all the other metals, platinum holding a position about midway between it and the other metals. The next step was to seize upon the hydrogen of the new compound and establish its activity, thus demonstrating that solidification of the hydrogen and not mere absorption or surface action is the cause of the altered appearance of the palladium. The great importance of this was evident to Graham, and, in connection with Mr. Roberts and Mr. Matthiessen, both skilful experimenters, he endeavored without success, by chemical means, to establish the activity of the hydrogen. Yet by reversing the electrical current, or by employing a piece of charged palladium as the electrode, on the electro-positive pole, no oxygen was seen to escape; thus proving the active state of the hydrogen, by immediately combining with the active oxygen, and forming water. Mr. Matthiessen was led to the same conclusion by a microscopical examination. A magnifying power of 500 to 600 diameters exhibited a slightly soiled palladium wire—soiled, perhaps, by merely touching it with the fingers—as having hills and valleys, like the moon as seen through an eight-inch refractor. A wire charged with hydrogen showed a smooth, even surface, with occasional hills, a diagonal cross section having the appearance of a layer of parallel wires; and on looking at the same wire, after expelling the hydrogen by heating it by means of a spirit-lamp, it presented the appearance of innumerable shreds, into which it seemed to have been torn by a violent internal explosion. The next paper was "On the Action of Sunlight on the Salts of Uranium," by Dr. H. C. Bolton, the substance of which has been published in the *American Journal of Science.* Mr. H. Wurtz then read a paper "On the Carbon Minerals," which he promised to introduce again at the next session, as want of time prevented the gentlemen present from entering into any discussion.

The Discovery of Rock Salt in Canada.—It is reported that extensive beds of rock salt have been discovered on the Canadian shore of Lake Huron. The discovery of rock salt in this portion of the North American Continent will not cause surprise, as the existence of extensive deposits in this region has long been indicated by the abundant flow of strong brine from the salt wells. Nine million bushels of salt were manufactured during a single season on the Onondaga salt reservation in New York State, and, notwithstanding the pumping of about four hundred and fifty million gallons of brine necessary to produce this quantity of salt, no change in the strength of the brine was noticed at the end of the summer.

The Manufacture of Zinc from the "dry bone" and "black Jack" of the Upper Mississippi lead region has become an important branch of industry. At La Salle, Ill., fifty tons of ore are smelted daily, three hundred men are employed, and one hundred tons of coal are consumed.

New Tin Deposits have been discovered in the coast range in Los Angelos County, California.

William B. Graves, M.A., a graduate of Amherst College, and for some time past Peabody Instructor in Natural Science, at Phillips Academy, Andover, has been appointed Professor of Natural Sciences in Marietta College, and accepted the position. He is expected to enter upon his duties there early in the spring.

Prof. Henry Morton, of Philadelphia, is to be the President of the Stevens Scientific Institute at Hoboken.

The Chemical Society of Berlin held a Hofmann festival on the evening of Jan. 8th, in honor of the founder of the Society, Professor A. W. Hofmann. Prof. Hofmann, who has enriched the science of chemistry by some of the most brilliant discoveries of the present century, was for many years in London, but has recently accepted a call to Berlin, where he has erected a very complete laboratory at a cost of four or five hundred thousand thalers.

The Faculty, Trustees, and Friends of the School of Mines of Columbia College have had a beautiful life-size medallion of President Barnard executed by Kuntze for the library of the school.

Scientific Lectures.—That science has become very popular in New York is shown by the number of scientific lectures and the large audiences that attend them.

Dec. 16.—Prof. Edward L. Youmans lectured on "*The Dynamics of Life.*" at Steinway Hall, under the auspices of the Society of Mechanics and Tradesmen.

Dec. 17.—President Andrew D. White, of Cornell University, lectured in the great hall of the Cooper Union, before the American Institute, on "*The Battlefields of Science.*"

Dec. 24.—Prof. E. S. Morse, of the Peabody Academy of Science, lectured at the Cooper Union, on "*How Animals Move,*" before the American Institute.

Dec. 31.—Prof. George F. Barker, of Yale College, lectured at the Cooper Union, before the American Institute, on "*The Correlation of Vital and Physical Forces.*"

Jan. 7.—Prof. R. Ogden Doremus lectured before the Young Men's Christian Association, in their new hall, on "*Gaseous Bodies and How they Become Solid.*" This is one of a series of lectures on the creation of the earth.

Jan. 7.—Prof. John W. Draper lectured before the American Institute, on "*Air and Respiration.*"

Jan. 8.—Prof. Ebell lectured at the Cooper Union on "*Animal Life.*" This is the first of the annual series of free lectures, given by the Trustees of the Cooper Union of Science and Art.

Brooklyn is not behindhand in supporting scientific lectures, Prof. George F. Barker delivered two lectures on "*Spectrum Analysis,*" to the fullest and best houses ever accorded to a public lecturer in that city.

THE CHEMICAL NEWS.
Vol. VI. No. 3. American Reprint.

NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

BY WILLIAM ARNOT, F.C.S.

I. Dr. Schiebler's Calcimeter.

The almost daily use, for some years, of Dr. Schiebler's expeditious instrument for the estimation of carbonic acid in carbonates, and the invariably consistent results obtained, have made it quite a favourite with the author of these notes. Believing the instrument to be far too little known, he would seek to call attention to its value, especially to those who have the charge of sugar refineries, where the frequent estimation of calcic carbonate in animal charcoal is a desideratum.

With a little practice, twelve or fourteen estimations may easily be made in an hour; and these, if upon the same finely-powdered sample, will, with ordinary care, be found to agree almost absolutely. The saving of time by this process over the most expeditious of the ordinary gravimetric methods (which alone are applicable to substances like bone-char) will be found to be very great. Starting in each case, with the sample in powder, the difference in time is such as easily to repay the first cost of the instrument by a few hours' work. As the instrument is sold with a normal weight and tables of calculated results, no time is lost in after calculations. The volume of carbonic acid, and the temperature indicated by the instrument, are referred to the tables, where the percentage quantity of carbonic acid or calcic carbonate is at once found. One great advantage of such an expeditious method as this is that there is no temptation to be satisfied with first results, as a few minutes suffice to repeat the process. A general description of the instrument and process, in English, will be found in the last edition of "Frcsenius" (Quantitative Part); but a perusal of the original German instructions will be found profitable.

In most freshly-burnt bone-chars, traces of sulphides are to be found. These, of course, vitiate the results obtained by Dr. Schiebler's instrument to a trifling extent; but the author has not found, over a wide experience (unless on one occasion), more than 0·5 per cent of the evolved gases to be hydric sulphide; so that, for all practical purposes, that may be entirely overlooked.

II. The Action of Finely-Divided Carbon on Solutions of the Chromates in Hydrochloric Acid.

On the occasion of finding excess of sulphides in a sample of bone-char, referred to above, an effort was made to oxidise the sulphur simultaneously with the evolution of the carbonic acid in the decomposing jar, but only with indifferent success. In the course of the experiments, undertaken with that end in view, a solution of potassic bichromate in strong hydrochloric acid was used. On decanting this solution from the little gutta-percha tube, upon the powdered charcoal in the decomposing jar, *instant* and *rapid* disengagement of chlorine resulted. It is well known that chlorine is *slowly* evolved from the solution referred to in the cold, *more rapidly* when heat is applied, and *still more rapidly* on the addition of alcohol and some other organic substances.* Animal charcoal, or bone-black, which produced the *instantaneous* effect referred to, is a very complex agent. Its peculiar action as a decolouriser is well known. It was, therefore, a question whether this was an action analogous to decolouration, or if it was due to the action of some individual substance present in the char. The various constituents were tried, one by one, in every case, without producing the result, unless with the carbon, which, when as pure as attainable, produced the very same result as the original powdered char. The char, minus the carbon only, had no effect. It was, therefore, clear that it was the carbon which had brought about the instantaneous decomposition. This carbon exists in a very fine state of division. Its action, in this case, must be analogous to that of platinum, in mysteriously determining the decomposition of certain substances, as the carbon itself is in no way acted upon. Further experiments were made, to determine whether this action was similarly promoted by other forms of carbon. Many varieties, from both vegetable and mineral sources, were tried; but in no case was the decomposition of the chromate solution promoted to any appreciable extent by their presence. Charred blood was also tried, and with more success, though the decomposition was by no means so rapid as in the case of the bone-char.

III. Prejudicial Action of Sulphites and Sulphates in the Refining Process.

Besides the impurities natural to unrefined cane sugars, and which vary in quantity, and to some extent in quality also, according to the care bestowed in the manufacture and other local circumstances, there are not unfrequently present one or more injurious agents which have been introduced, not as adulterants, but to counteract some adverse natural circumstance or action. Among these agents bisulphite of calcium occupies a prominent position. In several cane-growing countries, the natives, or colonists, are dependent, in great measure, upon wind power for the performance of certain mechanical operations; pressing the juice from the cane is one of these. The canes being ripe and the wind fair, the planter proceeds to cut down his crop; but, before this is well accomplished, the wind falls; what is to be done? To allow the cut canes to lie in their natural condition until a favourable breeze springs up, may be to submit to a very serious loss of crystallisable sugar by fermentation. To counteract this destructive process, bisulphite of calcium, mixed with water, to the consistency of ordinary milk of lime, is sprinkled over the canes from time to time, until the elements supply the necessary motive power to allow the pressing to proceed. As the pressing goes on, the lime salt mingles with the juice, and is never afterwards entirely removed from the manufactured sugar. Much of the raw sugar which arrives in this country, to undergo the process of refining, thus contains notable quantities of sulphites and sulphates; these range in quantity from the merest trace to amounts which might seem to some incredible. In these circumstances it becomes important to ascertain the action of these salts in the refining process, and their consequent effect upon the value of sugars containing them. In the first place, they, of course, in common with all other impurities, reduce the percentage quantity of saccharine matter in the sample; and as it often enough occurs that the *best looking* samples contain the impuri-

* *Gmelin*, Cav. Soc. Trans., vol. iv. p. 120.

[English Edition, Vol. XXI., No. 528, pages 1, 2.]

ties referred to in greatest quantity, it is always advisable to estimate the total impurities previous to purchase. The sugars being blown-up and mechanically filtered, are next submitted to the purifying and decolourising action of animal charcoal; in this process a large proportion of the sulphites and sulphates are removed and retained within the pores of the char. The washing, to which the char is afterwards subjected, removes a portion of these salts along with other impurities, but they are never entirely washed out. The re-burning succeeds the washing, and in this process the sulphates, or a portion of them, depending upon the temperature at which the re-burning is conducted and other minor circumstances, are decomposed at the expense of the carbon—carbonic anhydride being evolved and calcium sulphide formed. The char being re-burned and cooled is ready for its work of decolouration again; the sugar liquors—acid almost to a certainty—are run upon it, and as they pass through, decompose the calcium sulphide, with formation of hydric sulphide, which the liquors absorb. There are thus two prejudicial effects produced: first, the removal of a portion of the most valuable agent in the char—the carbon—and next the formation of an agent in the sugar solution, which is most potent in promoting fermentation, and consequent destruction of saccharine matter. The quantity of carbon removed and hydric sulphide produced by one complete circle of the refining process is comparatively trifling, but when it is remembered that the same char is often re-burned and used twice a week, the ultimate extent of the injury can be imagined. From extended personal observation, the author of these notes is satisfied that from 10 to 20 per cent of the decolourative power of animal charcoal may be destroyed in the course of twelve months by a continued use of sugars containing the agents referred to.

A little consideration will show, what numerous experiments have proved, that char *ready for re-burning* seldom or never contains sulphides, while re-burned char always contains more or less; *traces* of sulphur compounds being, as a rule, present in all unrefined sugars.

Long experience and numerous experiments have enabled the author to decide upon deductions to be made, from the marketable value of sugars, in proportion to the quantity of sulphates, &c., they contain. The mode of testing is exceedingly simple, but as the conclusions come to are quite arbitrary, so far as monetary figures are concerned, he would not advise the unexperienced to proceed upon his system, but would suggest to those interested in the problem a careful experimental investigation of the whole subject.

IV. The Chemical Impurities of "Low" Beet Sugars.

As a rule, the finest products of the beet are manufactured directly into loaves in the various beet growing countries; the second, or perhaps more frequently, the third crop of crystals being exported.

British refiners are thus called upon to deal with sugars containing large proportions of chemical impurities, some of them very injurious to the sugar itself, while others act most prejudicially on the charcoal used in the refining process. Amongst these agents, sulphates usually hold a prominent place; it is needless to say that their action is just as injurious in the product of the beet as in that of the cane. Alkaline chlorides also abound, and their action is at least as injurious as that of the sulphates. Any one who has had the opportunity of observing beet sugar liquor, and cane sugar liquor, of the same original colour, passed through separate cisterns of the same charcoal, must have been struck with the very great difference in the effect produced; the cane liquor bright and colourless, the beet *possibly* bright but decidedly yellow; and this difference is rather increased than lessened by the after process of boiling. The share which the alkaline salts have in reducing the colour value of the refined product is unquestionable, and their injurious action does not end there; they tend throughout the whole refining process to destroy crystallisable sugar, while their action on the charcoal, unless when very copious washing is practised, is very objectionable. The salts referred to, being fusible, the risk of coating the char in the re-burning process is considerable. Several otherwise good chars, which have been sadly injured in this way, have come under the author's observation. The practical point to be observed is this, that whereas even the very lowest "beets" commend themselves to the eye, in virtue of the size, strength, and abundance of the grains or crystals, they are often so charged with potent impurities, as to be entirely inadmissible as subjects for the British refiner to operate upon. The evil effects of the repeated use of such low-class beets soon manifest themselves over the whole refining establishment—not least on the sale-room counter.

The foregoing has, of course, little or no reference to the beautiful first products of the beet, occasionally imported, though even these are tainted, to a greater or less extent, with some of the characteristics of the low beets.

In the circumstances here noted, it must be manifest to every refiner, that to purchase beet sugars, or indeed any sugar, as will be evident from a perusal of the preceding (III.) note, by the rule-of-thumb system, so generally prevalent, is, to say the least of it, very risky.

Nothing but rigorous chemical examination can point out the true commercial value of unrefined sugars. The eye can detect many useful indications of quality, but these ought always to be supplemented by an investigation of the qualities which do not appear on the surface, and which chemical analysis alone can reveal.

Dubrunfaut, who, along with other continental chemists, has made the action of the impurities of beet upon the crystallisable sugar a special study, has fixed upon a coefficient by which to arrive at the quantity of *extractable* sugar contained in any sample submitted to analysis. The removal of these objectionable salts has also engaged the attention of several eminent continental chemists, and from the results obtained, it is manifest that other methods of dealing with beet sugars must be adopted from that followed in the refining of the produce of the cane. We in Britain seem to have fallen asleep upon this subject. The process of sugar refining is eminently a chemical one, and at every stage there is room for investigation and improvement.

V. Precautions to be Observed in Estimating the Relative Decolourative Power of Chars.

Simple as the process of testing the relative decolourative power of char samples may appear, very perplexing results are not unfrequently obtained. The object to be aimed at is to make the circumstances which obtain, as nearly as possible, the same on the small scale as on the large, and it is because many little precautionary measures which tend towards the attainment of that equality are usually omitted in the laboratory

that such conflicting and apparently inexplicable results are recorded. After many modifications of the process, the author is satisfied, from the results of experiments extending over a considerable period, that if the following points are carefully attended to, the results may be relied upon.

1. It must be decided what the results are to express; whether the relative decolourative power of *equal bulks* or *equal weights* of the chars, *irrespective of size and proportion of grain*, of the chars *uniformly freed from dust*, say by a fifty-mesh sieve, or of *equal weights* of *equal grains*.

2. According as either of these alternatives is decided upon, the various samples must be thoroughly and intimately mixed, and, if necessary, brought to an uniform dryness and temperature. It is always safest to have them thoroughly dry, and at the temperature of the surrounding air.

3. The various samples are next to be filled into glass tubes (tin may be used, but they preclude observations of a very important kind) provided with perforated false bottoms, covered with layers of cloth, and with taps capable of being accurately regulated. The tubes ought to be about 2 inches wide and 2 feet long, as nearly of the same diameter as possible. The best method of filling them is by passing the char through a funnel, keeping the spout of the funnel moving constantly in a circular direction, so as to have the large and small grains equally diffused throughout. To allow the char to run down either at one side, or, to a less degree, in the middle, is to cause to a certainty a separation of the larger grains from the smaller, and thus to create channels through which the liquor has too easy access.

4. See that no tube is touched or shaken more than the others, after the char has been filled in.

5. Sufficient brown sugar liquor, of, say, 24° B, must be prepared, either by diluting raw filtered liquor from the sugar-house to that gravity, or by dissolving as much of an average quality of raw material as will make sufficient liquor for the whole experiment. In the case of preparing it on the small scale, albumen or blood must be liberally used, and the liquor passed through paper filters—coarse French paper answers best. The albumen should not be added till all the sugar has been dissolved, and the temperature at, say, 160° F. An equal quantity of the prepared liquor, as nearly 180° F. as possible, must now be poured uniformly upon the char in each tube.

The rapidity with which the liquor passes through the chars in each case may be noted. Care must be taken to have the top of the char always covered with liquor, and the taps below open. As soon as the liquor begins to drop at the taps they are closed.

6. The tubes being fully charged with liquor (there should be as much left on the top of the char as will serve to force out the liquor in the char), they are put into a cistern of water at 140° F., the water in which will rise to about 1 inch from the mouths of the tubes, the time is noted, and the cisterns, which ought to be felted, covered.

7. At the end of not less than one hour (longer than one hour is sometimes advantageous, particularly if the raw liquor was very brown), the tubes are withdrawn, placed in their stand, and about 2 ounces of liquor run off each; this may be rejected, as the portion between the false bottom and tap is often turbid, and in addition has not been in contact with the char for a sufficient length of time. The remainder of the liquor, *i. e.*, so much as has actually been in contact with the char, may now be run off in three successive quantities for comparison. The results may be compared to any set of standard colours, and recorded accordingly.

8. If these results are not sufficiently instructive, a further quantity of raw liquor may be run on each tube, and the whole transferred as before to the water-bath, which, if felted, will still be hot enough. The second quantity of liquor will be run off with the same precautions as the first, and the results will show the *relative persistency* of the chars under trial.

If the taps are large the liquor will be likely to run off too rapidly, and, in that case, they had better be partially and uniformly closed.

If it is found that the liquor runs through one sample particularly slow, and through another particularly fast, it is quite admissible to assist the one by suction, and to check the other by closing the taps, but this should not be done unless in extreme cases, and the fact of having so assisted or retarded the process should always be noted.

It is scarcely necessary to mention the several points wherein the foregoing differs from the course usually pursued in testing chars, and yet it may be useful briefly to indicate some of these.

Too little care is usually bestowed upon the selection and preparation of the samples. The tubes used are, as a rule, too small; the char cannot be run so uniformly into small tubes as large ones. The samples once charged with liquor are not usually kept warm; it is essential that they should. Some chars act powerfully at low temperatures, while others require a considerable amount of heat to bring out their maximum decolourative power; care must, however, be taken that the temperature employed does not exceed that attained on the large scale in the refining process. The fact just noted does not seem to have been much investigated; it is worthy of careful consideration, not only on the part of experimentalists, but also by the practical refiner. One sample of char, known to be of very inferior decolourative power on the working scale, persistently gave results, by the usual method of testing in the laboratory, equal to the very finest chars obtainable, but when kept at an elevated temperature along with the finer samples, in the manner indicated above, its inferiority was at once manifest. The facts in this case were that the inferior char readily yielded *all* its decolourative power at the low temperature, while the finer samples required the influence of heat to call their whole power into action.

VI. The Constituents of Char, Important and Unimportant.

In the absence of a knowledge of the refining process, and the circumstances attendant on the use and revivification of animal charcoal, much time may be unprofitably spent over an analysis of that agent. While it is always desirable to have analyses carefully and accurately executed, the analyst should be able to discriminate between the essential and non-essential elements or compounds in the substance before him, and, while he aims at general accuracy, more than usual care should be bestowed upon substances the presence or absence of which mark the value of the agent under examination.

The points of greatest importance in an analysis of animal charcoal are the carbon, the carbonates, and the iron; the decolouriser, the neutraliser, and the destroyer. Under certain circumstances the sulphates

may also be included in the list, and in the case of new unused char the alkaline salts should be carefully estimated. These essential points carefully ascertained, no modification of them should be thought of, whatever the phosphates may come out. If the analysis should come to 105, ten to one but the phosphates are to blame and not the carbon and carbonates. The phosphates are comparatively unimportant, and when it is remembered how various are the methods employed, and how faulty some of them are,* errors under that head need not be greatly wondered at. There is no excuse whatever for error in the carbon, the process is simplicity itself; the carbonates can be quickly and accurately estimated by the calcimeter (Note I.), while the iron, after some little practice, can be safely got at by Penny's process, using a very dilute solution of bichromate. The iron is always in the state of protoxide, faint traces of peroxide excepted, owing to the reducing action of the carbon in the re-burning. Of course, these remarks are intended to apply exclusively to commercial samples for use in the refinery. When char is to be sold for the manufacture of manure the circumstances are altered, and the phosphates become the essential element in the analysis.

VII. M. Gaston Tissandier's Method of Analysing Animal Black.

When the author of these notes penned that immediately preceding this, he little thought that it was at all necessary to go into the details of the process of analysis, but contented himself by simply throwing out a hint or two upon the subject; the simultaneous appearance of M. G. Tissandier's notes upon animal black with his own has, however, shown him his mistake. The methods recommended by that gentleman are so faulty as to demand some special remark.

1. *The Carbon.*—M. G. Tissandier arrives at the proportion of this most important agent by a method which cannot be relied upon. The writer at one time thought that he had made a great time-saving discovery, when the idea of doing as M. G. Tissandier recommends struck him, but he soon found out his mistake: the difference between the "ash" and the original weight *does not* give the carbon and moisture. To whatever cause it may be due, the results obtained by this process always differ from those obtained by the more trustworthy method hereafter to be described. Two objections to M. G. Tissandier's process may be pointed out—There is always iron present in animal black, and, as indicated in the preceding note, it always exists as protoxide; this is, of course, peroxidised by M. G. Tissandier's process. The carbonates are liable to decomposition, and though caution, during the process of calcination, is recommended, the manipulator has no guarantee that he has not decomposed a portion of them; and to moisten with ammonium carbonate, as recommended by Dr. Wallace, is not at all safe. The analysis should always be made upon the dried sample—the moisture may, of course, be estimated in the usual way, in a portion (several hundred grains) of the original *unground* sample; but, with working chars, unless the sample is for sale, the moisture may be left out altogether. It may be necessary to state, as a reason for estimating the moisture in the original char in preference to the pulverised, that in the process of grinding, which occupies some time, the char, if comparatively dry, is liable to absorb moisture from the atmosphere. 50 grs. of the sample, in impalpable powder (which *should not* be sifted, but the whole reduced uniformly to the necessary fineness, the hard gritty grains which so persistently resist the action of the mortar and pestle sometimes, have usually a different composition from the softer portions, and ought not to be rejected, as M. G. Tissandier recommends), are boiled in dilute hydric chloride; twenty minutes are usually necessary to accomplish this satisfactorily. The insoluble is thrown upon a weighed filter, and very thoroughly washed; the filter, after drying, is weighed—the difference being carbon and sand. The drying and weighing must be very carefully attended to; after the first weighing, the filter should be returned to the drying oven, and after a time weighed again, and so on until the results are constant. The filter is then ignited, the residue being sand and clay; the weight of this, deducted from the previous result, will, of course, give the carbon, and that accurately. The carbon being a most, if not the most, important element in the char, its accurate determination must be made a point in the analysis.

2. *The Silica* by M. G. Tissandier's process will be found much too high; "water acidulated with chlorhydric acid," "slightly heated," will scarcely have the desired effect upon ignited "ash." The twenty minutes' boiling with moderately strong acid, referred to above, will be no more than competent to do the work indicated, but from the preceding remarks it will be seen that the sand, &c., can be got at otherwise.

3. *The Phosphates*—It seems passing strange that the system of precipitation by ammonia should again require to be publicly protested against. The results by this process are worth nothing; and how, otherwise than by accident, an analysis can be got to come to 100 when it has been employed the writer cannot guess. Perhaps if M. G. Tissandier had been asked to reconcile the phosphate results of different analysts (as the writer has been), he would long ere this have consigned the process to oblivion. Better leave the phosphates alone altogether than precipitate them by ammonia; the analysis will more likely be correct. Precipitation as ammonio-magnesian phosphate will, with care, give reasonably-accurate results.

4. *The Carbonates* must not depend upon the lime left over in the solution after the separation of the phosphates: many errors creep in here. The total lime should be estimated by precipitating with oxalate of ammonia, as a check upon the other results; but the carbonic acid itself must be the guide to the amount of carbonates. One process for carbonic acid has already been referred to with favour. In the absence of Dr. Schiebler's apparatus, however, some of the usual gravimetric methods admitting of the use of hydric chloride may be employed.

5. M. G. Tissandier makes no mention of iron in his analysis. He may be dealing all alone with new, unused char, in which the iron is usually very trifling; but he does not say so. The iron is an essential point in the analysis of used chars, and is not to be passed lightly over even in new, unused chars. As already indicated, its estimation may be accurately made by Penny's process. The strength of the bichromate solution best adapted for the delicate operation is 2·75 grs. of the pure and dry salt to 1000 grs. of water; in which case the alkalimetric measures consumed will be divided by 16 to give percentage of metallic iron—*i.e.*, supposing 100 grs. of the char to have been used. The process must be conducted neatly and rapidly, as the

* Chemical News, vol. xi., p. 49, *Eng. Ed.*

solution is liable to absorb oxygen from the atmosphere.

M. G. Tissandier concludes this part of his paper by appending the results of the analysis of three samples of char. The writer has seen and executed several hundred analyses of this agent, and never, in all his experience, has he met with more extraordinary results than those given by M. G. Tissandier, as illustrative of the composition of this substance (?). Are these the analyses of new chars, or old? Have they been used in the "beet" manufacture, or in connection with some special process? Where is the iron, and the sulphates? For what object are the results published? Without some information upon these points, they can only mislead the reader.

M. G. Tissandier's method of estimating the decolourative power of chars is very pretty, but of no practical value. The results will express *the relative power of pulverised animal-black to decolourise caramel;* but that is not what the sugar refiner requires. For sugar-refining purposes, nothing but sugar-refining methods of testing decolourative powers will do. The author has tried many devices, both with grain and pulverised char, with log-wood decoction, caramel, &c.; but the results in no case give the true value of the char to the refiner. The directions given in Note V. have been followed, with the most satisfactory results, for three years. During that time, several other *simpler* systems have been tried; but all have had to give way to the *more tedious, but accurate,* system described.

THE MODE OF TESTING MINERAL OILS USED FOR LAMPS.

BY BENJAMIN H. PAUL, PH.D.

The degree of inflammability of the mineral oil now used for lamps is a character which the chemist is sometimes called upon to determine; and since recent inquiries appear to indicate that there is considerable difference of opinion as to the mode in which mineral oil should be tested for the purpose of determining that character, I have thought that this subject, though not one of any scientific interest, would be worth bringing under the notice of the readers of the Chemical News, especially since the degree of inflammability of mineral oil is now attracting considerable attention in reference to the question of danger attending the use of such oil in lamps.

All kinds of mineral oil, whether derived from coal, or bituminous shale, or from petroleum, are, by their nature, more inflammable than the fat oils, such as sperm oil and colza oil, formerly used for lamps, that is to say, they take fire more readily and at a lower temperature than the latter; they also differ from those oils in being partially volatile at a temperature which has no similar effect upon the fat oils. Since the vapour thus given off is inflammable, and, when mixed with air in due proportion, capable of exploding, it is evident that the use of any kind of hydro-carbon oil requires, for both the reasons just mentioned, a greater degree of care than is necessary in the use of fat oils.

In considering the question of danger to be apprehended from the use of mineral oil in lamps, the conditions under which it is used in a general way must be taken into account; and so far as the inflammability of the oil is concerned, the point to ascertain is not merely what oil may be used without any necessary danger, but what kind of oil will answer the purpose for which it is required as an illuminating material without, at the same time, requiring any greater degree of caution in its use than can fairly be expected under the circumstances. Even the more volatile portions of petroleum and paraffin oil, constituting what is generally termed "spirit," or naphtha, benzoline, ligroine, &c., may be burnt without any necessary danger in some of the ordinary paraffin lamps, which are constructed in such a manner that there is no free communication between the flame and the oil reservoir. But this material, which begins to boil below 100° F., and distils over completely below 300° F., while it is readily volatilised at the ordinary atmospheric temperature by contact with air, is much too volatile for general use in that way, except in the special form of lamp known as the "sponge lamp;" and, for that reason, it can scarcely be regarded as a suitable material for burning in what is termed the paraffin-oil lamp. The fact that it can be used in this way serves merely to show that any danger attending the use of mineral oil in lamps is less referable to its volatility and greater inflammability, as compared with fat oils, than it is to carelessness, or misuse, and the neglect of those precautions which the nature of this material renders indispensable. But though the possibility of improper usage cannot reasonably be regarded as justifying any considerable restrictions in the application of a material so useful as mineral oil, still some allowance requires to be made for it; and since, in this respect, the degree of inflammability is the character of the greatest importance, it is customary, in the operation of refining, to separate and exclude from the oil to be used for ordinary lamps, a certain amount of the more volatile hydrocarbons contained in the crude petroleum or paraffin oil. The extent to which this is done is not in all cases the same, and there is some difference of opinion as to what should be the minimum degree of inflammability of the oil, or the minimum temperature at which it should be capable of giving off inflammable vapour, in order to ensure for it such a degree of safety as would be consistent with the general circumstances under which it is used in lamps and kept as a commodity in shops. By some, it is considered that when a flame is brought into actual contact with the oil, heated in an open capsule, it ought not to take fire, so as to continue burning, until the temperature reaches 130° F. Others, again, consider that, if it does not take fire at a temperature below 100° F., it is of a character fit to meet all requirements.

Hitherto, far less attention has been paid to the degree of inflammability of mineral oil than to the absence of smell and colour. It has also been customary in different countries to use oil differing widely in regard to the temperature at which it would take fire. Some years ago, the oil generally consumed in this country had a very high firing point, and it was customary to test it by observing how long it would bear contact with the flame of a match without taking fire, or more accurately by observing the temperature at which it took fire and continued to burn. This temperature was generally from 120° to 130° F., and sometimes it was as high as 150° F. The oils manufactured about eight years ago, from Rangoon petroleum, and from coal or bituminous shale, were of this kind. On the Continent, oil inflammable at a much lower temperature has generally been preferred.

After the introduction of American petroleum, there was a marked difference in the character of the imported lamp oil manufactured from this material, so far as re-

gards the degree of inflammability, and it would often take fire at a temperature little above 100° F. During the last three years, the firing point of this oil has been still further reduced, and probably the greater part of the lamp oil imported from America and made from petroleum, which has been consumed during that period has had a firing point below 100° F., sometimes considerably lower.

In addition to the differences, both of opinion and practice, in regard to the degree of inflammability of mineral lamp oil, there are also similar differences as to the mode of determining this character, and as to what is to be regarded as the firing point.

This oil being in all cases a mixture of several hydrocarbons belonging to the paraffin series chiefly, and varying in their boiling points from about 200° to upwards of 700° F., the temperature at which it begins to give off vapour will depend upon the boiling points of the more volatile hydrocarbons, and upon the amount of them contained in the oil. Consequently, when the oil is gradually heated in contact with air, and a flame is brought near the surface from time to time, there is always a little momentary flash, produced by the vapour taking fire; and this happens some time before the oil attains the temperature at which it takes fire itself, and continues to burn. The difference between the temperature at which the temporary flash takes place, and that at which the oil takes fire, will amount to from 10 to 20 degrees Fahrenheit.

Upon the assumption that an explosive mixture of oil vapour and air may be formed within the reservoir of a lamp, it has been urged that the temperature of the oil when this temporary flash takes place should be considered as the firing point of the oil.

The quantity of vapour given off by mineral oil at the temperature when the first temporary flash takes place, is generally very small, even when the oil itself takes fire at 100° F.; and as the oil in the glass reservoir of a paraffin lamp, while it is burning, seldom acquires a temperature more than about ten degrees above that of the surrounding atmosphere, there would not be much probability of any such quantity of vapour being produced within the reservoir as could give rise to explosion by contact with flame. In regard to this point, however, the construction of the lamp is of considerable importance. In some lamps the pin by which the height of the wick is adjusted is so arranged that there is free communication between the flame of the lamp and the oil reservoir, and between the two there is a small metal chamber, with a hole at the side, through which the pin passes. This chamber, in common with the other brass fitting of the lamp, being heated to a temperature much above 100° F., will of course become filled with vapour given off from the oil as it passes up through the wick; and that vapour, by mixing with air, may form an explosive mixture in the immediate neighbourhood of the flame. In other lamps the pin is fitted in such a way that there cannot be any accumulation of oil vapour near the flame, and there is not any communication between the flame and the reservoir, except through the tube in which the wick is placed. The latter form of lamp is in this respect much preferable to the other, and it is the only kind of lamp in which a very volatile oil can be burnt. But the fact of most importance in regard to the determination of the inflammability of mineral by the "flashing point" is that the result obtained with a given sample of oil in this way may vary several degrees, according to the mode in which the test is applied. If the surface of the oil is freely exposed to the air, in an open vessel, such as a shallow capsule, the firing point of the vapour may be found to be some degrees higher than when the test is applied in a small wide-mouthed bottle, or in the reservoir of a paraffin lamp, half-filled with the oil.

The difference before referred to between the temperature at which, in testing oil to ascertain the firing point, the temporary flash takes place, and that at which the oil itself takes fire and continues to burn, also depends very much upon the mode in which the experiment is made. With a shallow, open basin, the difference is much less than it is when a wide-mouthed bottle or a small lamp-reservoir is used. The more freely the surface of the oil is exposed to the atmosphere, the lower will be the temperature at which it takes fire; while, on the contrary, the less freely it is exposed, the lower will be the temperature at which the vapour given off takes fire. Consequently, in fixing a point of temperature as the minimum at which either the oil itself or the vapour it gives off should take fire by contact with flame, it is necessary that the conditions under which the experiment is to be made should be precisely defined, and that the testing of oils should always be conducted in the same manner, so as to obtain uniform and corresponding results. It is, of course, desirable, also, that these conditions should assimilate as much as possible to those obtaining in a paraffin-oil lamp when it is burning, since any danger that might arise from the inflammability of the oil would exist chiefly in the ordinary use of this material in lamps.

It is singular, however, that the Act passed in 1868, to amend the Petroleum Act of 1862, prescribes a mode of testing mineral oil under conditions that are the direct opposite of those prevailing in the use of the oil. While a mineral oil lamp is in use, the oil is heated in a closed vessel partly filled with air, which thus becomes charged with oil vapour, proportionately to the volatility of the oil, or part of it, and to the temperature the oil is raised to. Any oil vapour given off is confined; and, if the oil be sufficiently volatile or sufficiently heated, such formation of oil vapour may result in the production of an explosive mixture within the oil-reservoir of a lamp.

On the contrary, in testing mineral oil according to the directions given in the Schedule appended to the Act of 1868, the oil is heated in an open vessel, with the surface freely exposed to the atmosphere. Under these conditions, any oil vapour formed is liable to diffuse away into the surrounding air, and become thus so much diluted as to lose its inflammable character. Consequently, the temperature at which the momentary flash takes place with any given sample of oil when a flame is brought near its surface, will be, for that reason, higher than when the escape and dilution of the oil vapour is prevented—as in a paraffin lamp, or by making the test in a partially closed vessel.

A still more serious interference with the results of the test would be experienced if the operation were conducted in a place exposed to draughts; and probably much of the discrepancy in the results of oil-tests has arisen in this way.

But there is yet another source of discrepancy in the results of tests made in accordance with the directions of the Petroleum Act, and one which is of far more importance, because no notice is taken of it in those directions, and, consequently, its influence may be greater or less according to accident or to the practice of the operator. This source of error lies in the rate at which

the oil is heated, or the time occupied in making a test. All that the Act directs in this respect is that "a small flame shall be applied to the bottom of the outer vessel," which serves as a water-bath, and that this vessel "shall be filled with cold, or nearly cold, water." Both these directions are extremely vague. But, leaving out of consideration any difference that might arise from using "cold" water at 40° F., or "nearly cold water" at 70° F., the rate of heating the oil from either temperature up to 100° F. has such an influence on the result obtained that there may be a difference of quite 5° in the flashing point of a given sample of oil accordingly as the heating is made to occupy a longer or shorter time; and this will be the result, even though a "small flame" be used in both cases. Some experiments I have recently made show that there is a possibility of even greater variation in the result obtained as the "flashing point" of one and the same sample of oil.

Such a defect as this in the prescribed mode of testing mineral oil leaves the practice of this test entirely subject to the option or fancy of the operator; and it is alone sufficient to render the application of the test totally useless for the purpose of determining the character of mineral oil in regard to inflammability, and worse than useless for all the purposes of the Petroleum Act, besides rendering this Act and its application a possible source of serious inconvenience to those engaged in the mineral oil. On these grounds alone, therefore, there seems to be ample need for a revision of the law, and for the adoption of a more suitable test.

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ON CHEMICAL EQUILIBRIUM.

Influence of Pressure on the Reaction between Carbon and Hydrogen.

BY M. BERTHELOT.

The play of conflicting chemical reactions, and the equilibrium established between them, are simplest, theoretically, when such reactions are developed in homogeneous systems, entirely gaseous, or even entirely liquid, and capable of remaining homogeneous during the whole duration of the experiment.

Under these conditions, all the reacting particles remain in complete and unceasing contact, no secondary complication occurring to withdraw one of them from the field of chemical action. Not so in the case of reactions which take place between a gas, or liquid, and a solid; under these circumstances, reaction occurs only at the points of contact, which undergo the influence of numerous physical conditions, accessory and foreign to true chemical action, which they tend to complicate.

Meanwhile, the principal masses, separated from each other by the gaseous state of the one, opposed to the solubility of the other, remain neutral and inactive.

The homogeneous system is, therefore, in my opinion, the best adapted for the theoretical study of affinities—that is, the study of those forces which determine chemical combinations and decompositions.

From this point, my researches commenced upon the study of affinities, examined in ethereal reactions, which present a type of slow progressive action and of action limited by inverse reaction.

Ethereal reactions may be examined by an entirely gaseous system, or by one wholly liquid and permanently homogeneous. Their characteristic equilibrium varies continually with the relative proportions of reacting bodies, contrary to what occurs in reactions of acids on bases. It also varies continually in gaseous systems, according to the pressure—that is, according to the condensation of matter, but it is independent of temperature between the limits of zero and 280°.

The fundamental condition of homogeneity is, perhaps, fulfilled by reactions effected on the gaseous system under lively combustion, such as were studied with such advantage by M. Bunsen. Here the reactions are abrupt, and occur almost instantaneously: the equilibrium which generally arises between contrary actions no longer obeys the laws of continuity, but varies after the manner of chemical equivalents. When the proportions of reacting bodies change progressively—as, for instance, in systems formed of hydrogen, oxide of carbon, and oxygen, on the contrary, the relative proportions of products formed vary by abrupt leaps.

The relation between the entire volume of a mixture of combustible gas and that of the portion which will produce, at a given temperature, a new composition, also varies by abrupt jumps, when the temperature is gradually made to vary by introducing into the mixture an inert gas. There will then exist several intervals o temperature, more or less great, between which the limit of the reaction is independent of changes of temperature. To establish a complete parallel between ethereal reactions and those of the gaseous systems, the influence of pressure on the latter must be ascertained.

Between acetylene, hydrogen, and carbon reduced to vapour by the electric arc, or spark, such an equilibrium is established that a mixture of acetylene and hydrogen, made in suitable proportions, remains unaltered by the spark. If, on the contrary, acetylene predominates, it decomposes until the above-mentioned proportions are reproduced. These facts were established in a previous communication; since then, I have submitted a mixture of acetylene and hydrogen to the action of the spark under different pressures. This is my method of operation:—

The gases were contained in large eprouvettes, into which were passed gas tubes, bent round and traversed by thick platinum wire. The spark produced by a strong induction coil passed direct between the platinum wires, without breaking upon the glass or any other cold body capable of suddenly condensing the carbon vapour. The pressure was measured directly by the height of a column of mercury, and the mixture was analysed every hour, until the composition remained invariable during three consecutive tests. In the experiments made under very feeble pressure, it was necessary to repeatedly cleanse the eprouvettes containing the gaseous mixture, and, even then, to reject the first trials, because the formation of a small quantity of oxide of carbon proved the introduction of small quantities of air, or of moisture contained with the mercury. This oxide of carbon disappeared after the second or third trial, on care being taken to preserve from contact with the air the interior of the eprouvette and the tubes which conducted into it the platinum wire. The following results were obtained:—

Pressure. m.	Limit of Proportion of Acetylene In 100 volumes.
3·46	11·9
0·76	12·0 to 12·5 (in several trials.)
0·42	11·9
0·41	12·0

0·31	6·5
0·23	3·5
0·18	3·1
0·10	3·1

The pressure was not reduced further, because the volume of gas under treatment would have been too small for correct analysis.

These numbers prove that the equilibrium between the carbon, hydrogen, and acetylene remained fixed at the same limit (12·0) for pressures which varied from 0·41 m. to 3·46 m., that is to say, as 1 is to $8\frac{1}{2}$.

The increase of pressure has no effect but to augment extremely the resistance to the passage of the spark, and also its brilliancy. According to my experience, this increase of brilliancy does not correspond with any change in the composition of the gas traversed by the spark.

Even the rapidity of decomposition, which causes the disappearance of the excess of acetylene under treatment, does not appear to vary much with pressure, as far as it was possible to judge under the circumstances. Below 0·41 m.—that is, at 0·31 m.—the limit is suddenly brought down to 6·5—viz., half the preceding one. At 0·23 m., the limit is suddenly reduced to the quarter of it, and remains the same, at least to 0·10 m.

Thus, while the pressure varies continually, the equilibrium between the acetylene, carbon, and hydrogen changes, by sudden leaps, in ratios which are multiples of each other.—*Comptes Rendus*, vol. lxviii., p. 810.

ON THE

MICROSCOPICAL EXAMINATION OF MILK UNDER CERTAIN CONDITIONS.*

BY J. B. DANCER, F.R.A.S.

In August and September last an account appeared in one of the newspapers (and also in other periodicals), which had been copied from the *Journal des Connaissances Médicales*, of some microscopical observations made by M. V. Essling, on Milk, in which the author stated that "if the surface of fresh cream be examined under the lens, one perceives, amid myriads of milky and fatty globules, a number of either round or oblong corpuscles, sometimes accompanied with finely dotted matter, being neither more nor less than germinative masses of vibrios—just what is seen in most substances in a state of putrefaction. In summer these corpuscles make their appearance within 15 or 24 hours after milking; in winter they will be perceptible after the lapse of two or three days. If the observation be continued until the moment of coagulation, we see these corpuscles increase in number, bud, form ramified chains, and at length be transformed into regular mushrooms or filaments composed of cells placed end to end in simple series, and supporting at their extremities a spherical knob filled with granulous matter. M. V. Essling thinks that they may be classified among the Ascophora. But the important point is, that the first appearance of these spores occurs *before the milk gets sour*, and as this substance is almost the exclusive aliment of children, there is reason to suppose that many of the gastric affections to which they are subject are owing to this state of the milk. To prevent these evil consequences, M. V. Essling recommends the milk to be drunk as soon as possible after extraction, and, at all events, to keep it closely bottled during the interval so as to keep out the smallest particle of air. Moreover, the temperature should be kept as nearly as possible the same as that which the milk had in the teats."

Having for many years been familiar with the microscopical appearance presented by milk and cream, and not having seen the changes as described by M. V. Essling, I was desirous of satisfying myself on this point, more especially as it affected a very important article of food. The composition of ordinary milk, as stated by Fownes, is as follows:—

Water	873·00
Butter	30·00
Casein	48·20
Milk sugar	43·90
Phosphate of lime	2·31
Phosphate of magnesia	0·42
Phosphate of iron	0·07
Chloride of potassium	1·44
Chloride of sodium	0·24
Soda in combination with casein	0·42
	1000·00

Composition of casein in 100 parts:—

Carbon	53·83
Hydrogen	7·15
Nitrogen	15·64
Oxygen } Sulphur }	23·37
	100·00

Composition of albumen in 100 parts:—

Carbon	53·5
Hydrogen	7·0
Nitrogen	15·5
Oxygen	22·0
Phosphorus	0·4
Sulphur	1·6
	100·00

Casein and animal albumen are remarkably similar in composition; casein differs in not being coagulated by heat, and is precipitated by acetic acid. Certain animal substances cause its coagulation, such as the dried stomach of the calf, known as rennet, used in the manufacture of cheese.

When a thin film of milk is examined with the microscope, it is found to be a transparent fluid, in which are floating numerous transparent globules of fat; these are surrounded by a thin pellicle, and when this pellicle is broken mechanically, as by churning, the fat is liberated and forms butter. The fluid part consists of casein, saccharine matter, and salts in solution. The proportion of these organic principles varies in different animals, and also in the same animal when fed under different conditions. Human milk usually contains a larger proportion of sugar than cow milk, and is coagulated with greater difficulty. It is well known that the secretion and quality of milk is influenced by the mental emotions. Milk as obtained in towns is frequently adulterated, and as foreign matter would alter its microscopical characteristics, it was necessary to procure pure milk. One of our members, Mr. Kipping, kindly supplied me with a bottle of fresh-drawn milk. The cow had calved about three

* Read before the Manchester Literary and Philosophical Society, November 30th, 1869.

months previously, and had been fed on grass, bran, and bean-flour. This milk was examined soon after I received it, and was found to be very rich in oleaginous globules, forming a plentiful supply of cream. There was no appearance of dotted matter or any fungoid growth when examined by powers varying from 200 to 1500. The smallest oil globules exhibited (as usual) great molecular activity. A bottle was filled with some of this milk, and securely corked; other portions of the milk were placed in open cups; one cup was kept in a cabinet which was closed during the day, the milk of the second cup was placed in a closet, the atmosphere of which I knew to be favourable to the growth of fungi, the Mucor Mucedo being the most abundant and of the same family as that mentioned as having been found in cream by M. V. Essling. The milk in the bottle and that in the cups was examined daily, precautions being taken to close the bottle speedily after a portion was removed. On the third day, the milk in the open cups was sour to the smell, but no change appeared visible under the microscope; the upper portion of the milk in the bottle had become very rich in oil globules by the formation of cream. On the fourth day the casein had coagulated in the milk in the open cups, and the flaky precipitate was visible under the microscope; the pellicle surrounding the oil globules now appeared to be very easily ruptured, and with the slightest pressure some of the globules could be joined together—sometimes a number of globules which had been ranged in line by a current would coalesce by a slight movement of the fluid, and form an elongated mass. Fifth day, no appreciable alteration. Sixth day, the milk which had been placed in the closet had patches of mould visible on its surface; a microscopical examination of this mould showed it to be the Mucor Mucedo, such as I had frequently found on fruit which had been left in this closet. The fungi appeared on the surface only, no trace of it could be found in the milk taken from various depths. The milk in the cup kept in the cabinet exhibited no appearance of the Mucor Mucedo or any other vegetable or animal organism; it had become thickened into a pasty mass, with an intensely sour odour. These observations were continued for eleven days, and the only difference observable was in the oil globules—they began to lose their spherical form, as if the investing pellicle had been weakened in parts and had become expanded.

These experiments were repeated with a second supply of milk, which Mr. Kipping kindly supplied, and the results were alike in both cases. The range of temperature during the experiments was from 45° to 63° F. These experiments would lead me to believe that vegetable organisms do not, as a rule, make their appearance in pure unadulterated milk, unless it is exposed for some time to atmospheric influences; most probably the spores are supplied by the atmosphere. Further experiments are wanting to decide the question. The microscopical examinations should be continued in hot weather. I hope to be able to resume the enquiry next summer under different conditions, which have suggested themselves during the examination I have detailed. In any case, M. V. Essling's suggestion to bottle the milk is very good, and, in my opinion, cream pans with covers would be a very great improvement on the open ones as at present employed, at the same time having due regard to the cleanliness of the apartment and vessels in which the milk is kept.

In a microscopical examination such as I have recorded it is quite necessary to have pure materials. The milk as supplied by vendors we know to be very frequently adulterated, and the most simple and easy method is by the addition of water. We know also that in towns where the water has a high character for purity, it sometimes happens in dry hot weather the reservoirs are charged with vegetable and animal organisms. Milk may not always have town's water added to it; in this case there may be an extra quantity of vitalised matter introduced. What a surprising account a microscopist might furnish from the examination of milk containing such an importation! In the cold weather, such as we have at present, animal organisms are not so abundant, and this may account for their absence from a sample of milk obtained in this town, in which I found *Algæ*, but not belonging to the pure milk. One curious circumstance was noticed in this milk, no Mucor Mucedo appeared in or on it, although exposed in the closet for the same length of time as Mr. Kipping's milk, which showed signs of this growth on the sixth day, and on the twelfth day the town milk had none visible. I may mention that pure milk in a bottle securely corked remained fresh twelve days; possibly the low temperature favoured its preservation.

ON THE

ACTION OF CYANOGEN ON ANTHRANILIC ACID.*

BY P. GRIESS, F.R.S.

Some time ago,† I pointed out the action which takes place when cyanogen gas is passed into an alcoholic solution of amidobenzoic acid. The principal product of this reaction is, as I have shown, a yellow compound of cyanogen and amidobenzoic acid, of the formula—

$$C_7H_5(NH_2)O_2,2CN,$$

which separates in large quantities as soon as the alcoholic solution of amidobenzoic acid is nearly saturated with cyanogen. When anthranilic acid (a body isomeric with amidobenzoic acid) is submitted, under the same condition, to the same reagent, a totally different reaction takes place. In this case, the solution remains either perfectly clear, or only traces of a similar yellow compound are precipitated. By allowing the alcoholic solution of anthranilic acid saturated with cyanogen to stand for several days, the acid is almost entirely converted into a new compound of the empirical formula $C_{10}H_{10}N_2O_2$; two other new compounds (an acid and an indifferent body) are at the same time formed. It is worthy of remark that none of these compounds are isomeric with any of the bodies which, by the same process, are formed from amidobenzoic acid. Each of them belongs to a different type.

I propose on this occasion to treat only of the principal product of the reaction—viz., the compound $C_{10}H_{10}N_2O_2$. It is prepared in the following manner:—An alcoholic solution of anthranilic acid is saturated with cyanogen gas, and left to stand for about eight days. The alcohol is then evaporated at a low temperature, and the crystalline residue washed several times with dilute solution of carbonate of ammonia, by which any traces of the new acid (one of the by-products of the reaction) are removed. It is then further purified, by re-crystallisation from alcohol, with the addition of a little animal charcoal. The indifferent body already

* A paper communicated to the Royal Society.

† *Zeitschrift für Chemie*, new series, vol. iii., p. 533, and vol. iv., p. 389.

referred to, which is very little soluble in alcohol, is thus separated. The new compound, $C_{10}H_{10}N_2O_2$, is then obtained in the form of white acicular crystals, which are very little soluble in boiling water, but dissolve readily in boiling alcohol and ether. It fuses at 173° C., and can be distilled in small quantities, without undergoing decomposition. Its formation may be expressed as follows:—

$$\underbrace{C_7H_7NO_2}_{\text{Anthranilic acid.}} + \underbrace{2CN}_{\text{Cyanogen.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}} = \underbrace{C_{10}H_{10}N_2O_2}_{\text{New Compound.}} + \underbrace{CHN}_{\text{Hydrocyanic acid.}} + \underbrace{H_2O}_{\text{Water.}}$$

According to this equation, alcohol, as well as anthranilic acid and cyanogen, take place in the reaction. Confirmatory experiments which I have made show that the compound in question is really an ether.

Action of Hydrochloric Acid upon the Compound $C_{10}H_{10}N_2O_2$.—Ordinary hydrochloric acid dissolves this body, and, when cold, does not act upon it. On boiling, however, speedy decomposition sets in, and a new body separates, the formation of which is represented by the following equation;—

$$\underbrace{C_{10}H_{10}N_2O_2}_{\text{New Compound.}} + H_2O = \underbrace{C_8H_6N_2O_2}_{\text{New Compound.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}}$$

This new compound, $C_8H_6N_2O_2$, is very difficultly soluble in boiling water, alcohol, and ether, and crystallises in small white brilliant plates. It is likewise dissolved by solutions of caustic alkalies, but is again, however, separated by carbonic acid. On adding a solution of silver salt to its aqueous or alcoholic solution (neither of which has any action on vegetable colours), a white precipitate is formed. Fuming nitric acid converts this body into a nitro-compound, crystallising in honey-yellow prisms, of the composition $C_8H_5(NO_2)N_2O_2$. On treating the latter with sulphide of ammonium, or with tin and hydrochloric acid, it is reduced, and furnishes a basic amido-compound, crystallising in slightly yellowish-tinted needles, difficultly soluble in all neutral liquids. Its composition is $C_8H_5(NH_2)N_2O_2$. Compounds of this amido-body, with acids, crystallise well generally, but are, for the most part, difficultly soluble.

Action of Ammonia on the Compound $C_{10}H_{10}N_2O_2$.—On digesting the body for several days, at 100° C., in sealed tubes, with alcoholic ammonia, it is gradually converted into a base, almost insoluble in water, and difficultly soluble in boiling alcohol. From this it crystallises in brilliant nacreous plates.

Its composition agrees with the formula $C_8H_7N_3O$, and its formation takes place according to the equation—

$$\underbrace{C_{10}H_{10}N_2O_2}_{\text{New base.}} + NH_3 = \underbrace{C_8H_7N_3O}_{\text{New base.}} + \underbrace{C_2H_6O}_{\text{Alcohol.}}$$

This new base is monacid. Its nitrate is especially characteristic, for it is almost insoluble in water and alcohol. It separates out from very dilute solutions of the base, in the form of small white plates, on the addition of nitric acid. Its platinum-salt crystallises in thick yellow needles, and has the composition—

$$2(C_8H_7N_3O), 2HCl, PtCl_4.$$

The compounds just described may, one and all, be viewed as substitution products of anthranilic acid, viz:—

Anthranilic acid.....	$C_7H_7NO_2$ = $C_7H^6NO.HO$.
New ether.....	$C_{10}H_{10}N_2O_2$ = $C_7H_5(CN)NO.C_2H_5O$
Product of decomposition of the former with HCl	$C_8H_6N_2O^2$ = $C_7H_5(CN)NO.HO$.
Nitro-compound.....	$C_8H_5(NO_2)N_2O_2$ = $C_7H_4(NO_2)(CN)NO.HO$.
Amido-compound.....	$C_8H_5(NH_2)N_2O_2$ = $C_7H_4(NH_2)(CN)NO.HO$.
Base obtained from the ether by the action of NH_3....	$C_8H_7N_3O$ = $C_7H_5(CN)NO.H^2N$.

As I intend taking an early opportunity of considering the rational constitution of these bodies somewhat more fully, I content myself, for the present, with remarking that I am inclined to regard the base $C_8H_7N_3O$ as the creatinine of the benzoic series; it stands to anthranilic acid exactly in the same relation as creatinine *par excellence* does to sarcosine—

$\underbrace{C_8H_7N_3O}_{\text{Benzo-creatinine.}}$	$\underbrace{C_4H_7N_3O}_{\text{Creatinine.}}$
$\underbrace{C_7H_7NO_2}_{\text{Anthranilic acid.}}$	$\underbrace{C_3H_7NO_2}_{\text{Sarcosine.}}$

Herr Neubauer has shown* that creatinine, when treated in a sealed tube with baryta-water, undergoes the following change:—

$$\underbrace{C_4H_7N_3O}_{\text{Creatinine.}} + H_2O = \underbrace{C_4H_6N_2O_2}_{\text{Methylhydantoine.}} + NH_3.$$

I consider it highly probable that the base $C_8H_7N_3O$ will split up in like manner, with the formation of the above-described compound, $C_8H_6N_2O_2$, according to the equation—

$$C_8H_7N_3O + H_2O = C_8H_6N_2O_2 + NH_3$$

Indeed, this latter compound exhibits great resemblance in its chemical deportment to the methylhydantoine of Herr Neubauer.

In conclusion, I should point out that the azodioxindol described by Herrn Baeyer and Knop, in their paper "On Indigo Blue," is isomeric with the beforementioned compound, $C_8H_6N_2O_2$. These two bodies show, moreover, great similarity in other respects, so much so that I should feel inclined to view them as identical, if their fusing points did not differ essentially. Herrn Baeyer and Knop state that the fusing point of their azodioxindol is 300° C.; while the compound I obtained fuses above 350° C. Should it turn out, however, on further investigation, that the two bodies are identical, the compound $C_8H_6N_2O_2$ would have to be regarded as the first derivative of indigo which has ever been prepared synthetically, and which, like indigo blue itself, contains 8 atoms of carbon.

ON THE

SUCCESSIVE ACTION OF SODIUM AND IODIDE OF ETHYL ON ACETIC ETHER.†

BY J. ALFRED WANKLYN.

In a remarkable paper which appeared in the *Philosophical Transactions* (vol. clvi., p. 37, 1866), Frankland and Duppa described the products obtained on treatment with iodide of ethyl of the yellow wax-like mass given by the action of sodium on acetic ether. Besides the description of the compounds, Frankland and Duppa give a theory of their origin, which theory

* *Ann. der Chem. und Pharm.*, vol. cxl., p. 26.
† A paper communicated to the Royal Society.

is embodied in four equations, expressive of Frankland and Duppa's view of the origin of the wax-like mass. As I have already pointed out, each one of these four equations affirms the evolution of an equivalent of hydrogen by every equivalent of sodium employed.

It is an established fact that neither acetic ether, nor any other ether, ever evolves hydrogen by reaction with the alkali metals. All equations which assume evolution of hydrogen in these reactions are, therefore, inadmissible.

At the end of my paper in the January number of Liebig's *Annalen*, I promised to give an explanation of Frankland and Duppa's products, which should not involve the assumption of evolution of hydrogen. That explanation I now give.

On reference to Frankland and Duppa's paper just cited, it will be found that the products described by them as obtained from the "wax-like mass" and iodide of ethyl are the following :—

(A). $C_8H_{14}O_3$, liquid boiling at 195° C.
(B). $C_{10}H_{18}O_3$, liquid boiling at 210° C. to 212° C.

butyric ether, caproic ether, and also some unacted-upon acetic ether, and a considerable quantity of common ethylic ether.

The history of these compounds is, therefore, the task set before me.

I have already shown that the direct products of the action of sodium on acetic ether are ethylate of sodium and sodium-triacetyl. Nothing else seems to be produced directly; but the excess of acetic ether, which is necessarily taken, acts on some of the ethylate of sodium, producing alcohol and acetate of ethylene-sodium in the manner described by me on a former occasion. (Of course, the extent to which this secondary action takes place will be determined by the exact circumstances of the experiment.) We have, therefore, in the wax-like mass, got, by prolonging the action of sodium on acetic ether—

Ethylate of sodium.....C_2H_5NaO.
Sodium-triacetyl.....$C_6H_9O_3Na$.
Acetate of ethylene-sodium..$C_4H_7NaO_2$.
Alcohol.....C_2H_6O.

On the first three, iodide of ethyl acts, giving iodide of sodium and organic liquids.

From the ethylate of sodium comes the common ether.

From the sodium-triacetyl comes ethyl-triacetyl, which is $A = C_8H_{14}O_3$, having been got by Geuther from the pure sodium-triacetyl.

From isolated acetate of ethylene-sodium and iodide of ethylene, I have recently obtained liquid B ($C_{10}H_{18}O_3$) thus :—

Acetate of ethylene-sodium. Alcohol.
$$2C_4H_7NaO_2 + 2C_2H_5I = 2NaI + C_2H_6O + C_{10}H_{18}O_3.$$

The liquid prepared by me boiled at 212° C., and gave carbonate of baryta with baryta-water, and was identical with Frankland and Duppa's liquid B.

By the action of liquid A upon ethylate of sodium, Geuther has recently shown that butyric ether is produced. Geuther's reaction I write thus :—

Acetate of ethylene-sodium. Butyric ether.
$$(A).\ C_8H_{14}O_3 + C_2H_5NaO = NaC_2H_4,C_2H_3O_2 + C_6H_{12}O_2.$$

Finally, I predict that liquid B will give—

Caproic ether.
$$(B).\ C_{10}H_{18}O_3 + C_2H_5NaO = NaC_2H_4C_2H_3O_2 + C_8H_{16}O_2.$$

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Am. Repr., Feb'y, '70, page 60.)

From the explanation already given of the various modes in which light may be polarised, it is evident that one-half of the illuminating power is thrown away by the use of the polarising prism; this loss becomes a very serious matter when high magnifying powers are used, and as much valuable work is to be done by employing polarised light in combination with objectives of ½ inch and shorter focus, it becomes necessary to find some means of increasing the intensity of the illuminating pencil under such circumstances. Polarised light can be concentrated by lenses in the same manner as common light, and, after condensation, still retains its peculiar properties. In large microscopes, provision is made for fitting the Nicol prism below the achromatic condenser, and a set of Darker's selenites between them; this, with a good tourmaline or Herepathite for an analyser, will enable observations to be carried on with very high powers, and with nearly the same ease as by ordinary illumination. With small microscopes, Collins's Webster condenser, which is constructed to carry a Nicol prism, will be found a very efficient illuminator; as its lenses are large, and it supplies an excess of light when used without diaphragms, it will be found very suitable for polarising purposes. Its capability of being adapted to any instrument is another recommendation. The author can speak favourably of its performance with his own microscope, in which the unusually short distance between the stage and mirror prevents the use of any other condenser. The selenites can be placed between the Nicol prism and the condenser, as usual in microscopes with substage fittings, but with small instruments the stage arrangement must be used; the focus of the Webster is sufficiently long to work through the three selenites without material injury to the illumination, when Mr. Bailey's or other thin mounting is employed.

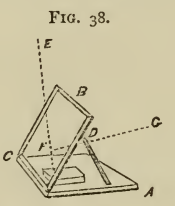
In carrying on observations by the aid of polarised light, it is necessary that the substance to be examined should be rendered as transparent as possible, by immersion in a suitable medium. Those which render objects so transparent that the details are almost invisible under ordinary illumination, are in general very suitable for polariscope purposes.

The facts which polarised light reveals are principally differences of density in tissues, the existence of which we should not be aware of without such aid. With regard to crystals, the polariscope at once distinguishes those which belong to the cubic system, such as common salt, which has no doubly refractive power, and, in common language, does not polarise, from those of the other systems, which, owing to their double refraction, are among the most brilliant of polariscope objects. Not only differences of density are made evident by the use of polarised light, but also minute variations of thickness when the substance examined is possessed of doubly refractive properties, which are at once shown by a difference of colour which defines the boundaries of the thickened portion, although this from the hyaline nature of the substance might be perfectly invisible when illuminated in the ordinary manner. This is

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

very often the case with the secondary deposits in vegetable tissues, which are to be seen most clearly when viewed with polarised light and sufficiently high powers. Sections of such substances as horn and tissues resembling it, as whalebone, &c., which exhibit little or no structure with common light, at once display differences of density indicated by colour when examined with the polarising microscope. A very interesting microscopic object is made by Mr. Bailey, consisting of a bar of glass, which is capable of being pressed by a screw. This, when examined by polarised light, exhibits no doubly refractive appearances so long as the screw does not touch it; but when pressure is applied, dark or coloured bands make their appearance around the point of the screw, extending to a greater or less distance, according to the amount of pressure employed, showing at once that some change has taken place in the molecular arrangement of the glass. Nearly similar bands are to be seen along the sides of a recent diamond cut and around the dot made by a slight blow of a steel centre punch, in both cases showing that the glass has been subjected to some strain. Opticians, in fitting lenses into cells, are careful to avoid pinching the glass, lest double refraction should be produced. Coloured bands are easily seen in pieces of thick plate-glass which have been rapidly cooled. These are best shown in Lecount's polariscope (Fig. 38), in which the polarised ray, G, is made to pass

Fig. 38.



twice through the piece of unannealed glass, F, which very much increases the intensity of the coloured bands. In this simple instrument the bundle of glass plates, B, acts as a polariser by reflection, and at the same time as an analyser by refraction, the light being reflected from the bundle through the object, and returned through it by the mirror, C, the bundle analysing the polarised ray, F, on its passage through it to the eye at E. The colours produced by varying thicknesses of selenite may be seen with the microscope in a small piece, roughly split, and mounted in balsam. It will be found that there will be a change of colour at every difference of thickness.

The object should be viewed, in the first instance, with the selenite plate, and the appearances noted which present themselves when both analyser and polariser are rotated. If the construction of the microscope permit, the object itself should also be rotated. Should no effect be produced by the prisms alone, a selenite may be used, commencing with one of little retarding power as ¼ of Darker's series. This should be rotated, and also the prisms before going through the various degrees of retardation.

Substances having a very feeble doubly refractive power are much assisted by using a selenite of suitable thickness, and details are often better seen with selenites of one colour than another. Darker's series offers great facilities for readily obtaining the most suitable tint. When a less power than that given by the ¼ is required, it can be obtained by turning the plate more or less towards one of the optic axes, which are situated at 45° from the P. A. mark, and the other depolarising axes. Also by using plates of mica, thin enough to just let a little light into the darkened field. Care should be taken to use sufficient light, and employ the condenser whenever necessary. As a general rule, with high powers, the light cannot be too strong; sometimes direct sunlight may be used with advantage. The effect of increase of illuminating power with the polariscope is not that of dilution, like excess of light pouring through a transparent coloured object, but as the coloured wave is augmented, intensity of colour and stronger definition is the result.

The polarising microscope is a great aid to the knowledge of structure, and an examination cannot in any way be considered as complete in which this most searching mode of investigation has been neglected. Hitherto, the polariscope has been considered rather in the light of a toy than as a valuable instrument of research, and it has therefore become necessary to devote so much of this elementary course of instruction to the application of polarised light to microscopical purposes.

The processes of recording microscopical observations are scarcely less important than those employed in making them. The facts accumulated by the most painstaking observers are of comparatively little use unless means are found of preserving and communicating them to others. This is particularly the case with regard to microscopical studies, and, like most natural-history observations, written descriptions, however graphic, are scarcely intelligible unless accompanied by truthful drawings. The concluding portion of these papers could, therefore, hardly be considered as complete without some mention of the way of writing this language of all nations, a subject which has, with a few exceptions, met with but little attention from writers on the microscope; probably being very expert themselves, the idea prevailed that drawing was as natural an acquirement as writing, and that no special directions were needed. The lectures which supplied the matter for these pages being intended for persons wholly unacquainted with the use of the microscope, it was then deemed advisable to treat upon the subject of microscopical drawing and micrometry at greater length than usual, dwelling especially on those points upon which little information is to be found in books; and the author has seen no reason to alter his opinion since the delivery of the lectures, but has rather added than withdrawn matter.

Photography, from its extreme accuracy and delicate rendering of details, claims a very high place among the resources of microscopical art. When the object is suitable for its employment, the result is not to be equalled by any other means of delineation. The conditions, however, which it is requisite to comply with in order to obtain a successful micro-photograph somewhat limit the cases in which it is available. The object to be photographed should be very thin and flat, so that the whole, or the greater part of it, lies in the same plane, that it may all be in focus at once; the reduction of aperture commonly used by landscape photographers to secure focal depth not being practicable, on account of the great loss of light occasioned by the use of small diaphragms, which is so great when the object is much magnified as to render the production of an impression on the prepared plate impossible with any reasonable amount of exposure. This is a very great drawback, as many of the most interesting microscopical objects can scarcely be seen without continual alteration of the

focal adjustments. The colour of the object should also be such as is favourable for photographic purposes; the yellow, brown, and red tints of many tissues render it impossible to obtain any satisfactory result. The best photographs are always those obtained from colourless objects, such as the *Diatomaceæ*, the delicate sculpture on the frustules of which are marvellously rendered, as may be seen by examining the photographs by Dr. Maddox, to be procured of Mr. How, of Foster Lane, at a merely nominal price. So minutely are the details produced that they will, when photographed upon glass, bear a considerable amount of enlargement by means of the magic-lantern.

At present only objects illuminated by transmitted light have yielded impressions on the prepared plate, the more feeble images obtained from reflected light and dark field illumination have failed in producing photographs, and so a large and interesting class of objects is excluded. Possibly future improvements may remove this, and some other difficulties which at present limit the use of this valuable art. The necessity of employing special apparatus and of mastering a delicate set of chemical processes will, it is to be feared, prevent many microscopists from availing themselves of photography as a means of delineating the objects presented to them in the course of their studies.

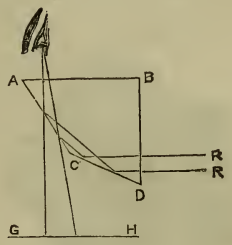
The practical details of manipulation and the bibliography of the subject are treated at considerable length in Dr. Beale's "How to Work with the Microscope," 4th edition, pp. 229 to 279.

Fortunately, the other processes used in making representations of objects are within reach of the majority of microscopists. The apparatus being simple and inexpensive, compared with that needed for obtaining photographs, and the use of it so easily mastered, that, with a little perseverance, most persons will be found able to obtain drawings really useful, although, perhaps, somewhat wanting in finish and delicacy. Even these may be attained in some degree by painstaking application; and, although the student's productions may not equal the work of professional artists, they will be found to possess an amount of truth which would most likely be wanting in the work of a more accomplished but less scientific draughtsman.

The simplest, but not the easiest, method is to make the drawing without instrumental aid. Few but those who are expert draughtsmen can accomplish this. The difficulty of obtaining anything approaching an accurate representation can only be understood by those who are familiar with the process. The chief obstacle is the impossibility of seeing object and drawing nearly together, as in landscape or other sketching, and the consequent trouble occasioned by frequently losing the place, especially during the earlier stages of the outline; the peculiar view afforded of the object depriving the observer of those guides used in ordinary drawing from nature. The impossibility of making the drawing to scale is another disadvantage, and renders it of but little value as a microscopical record. For objects in active motion no other mode is available, and in such cases it is of value, also, for making slight sketches and memoranda during observations, and preserving facts which would otherwise be lost; but where considerable accuracy is needed some one or other of the instrumental appliances now to be described must be employed. Nearly all the instruments attached to the microscope with a view to aid delineation act upon the principle of rendering the image of the object and the paper and pencil-point visible together and apparently blended. This may be accomplished in several ways, although the principle of reflection is used in all cases.

The oldest of these instruments is the *camera lucida* of Dr. Wollaston; it consists of a four-sided glass prism (Fig. 39), of which the angle A, B, D equals 90°, the

Fig. 39.



angles B, A, C, and B, D, C, 67° 30′, and the angle A, C, D, 135°; it acts by twice reflecting the rays R and R′, proceeding from the eye-glass of the microscope, which enter through the side B, D, first at C, D, and afterwards at A, C, to the eye, so placed at A that one-half of the pupil is over the edge of the prism, and views the image of the object in the microscope, the pencil and paper being seen by the other half, which is placed beyond the edge A. As the reflections are internal,* there is scarcely any loss of light; the image is consequently very bright, and owing to its being twice reflected, it is not inverted when it reaches the eye. The prism is mounted in a convenient setting, so that it may be fitted over the eye-piece in the place of the cap, which is of course removed. A lens is sometimes attached to the lower part of the camera lucida, between the eye and the paper; this is of use to persons who cannot see the drawing distinctly at the usual distance, about ten inches, and may be either convex or concave, according to the special requirement of using it.

A small steel disc, known as *Soemmering's mirror*, placed at an angle of 45°, is used by some microscopists. The polished disc is smaller than the pupil of the eye; so that, while the image from the microscope is viewed by the centre of the pupil, its circumference is employed in viewing the paper and pencil point, upon which the image appears to be projected, as in the camera lucida.

Another contrivance, and one which has the recommendation of being procured at a very small cost, is the *neutral tint reflector* (Fig. 40). It consists of a small plate of glass, with surfaces accurately parallel and slightly colored, so as to improve its reflecting qualities, but not sufficiently dark to prevent the paper from being easily seen through it. This is placed, as before, at an angle of 45°. As the instrument is commonly constructed, the tinted glass is a fixture, and the setting too long; so that the mirror is removed to a greater distance than is advantageous from the front glass of the eye-piece; this contracts the field so much, when any but an eye-piece of low power is employed, that it is almost useless. This defect is remedied in the form here represented, in which the mirror is brought as close as possible to the eye-glass. The tinted glasses are also removable, so that a change of tint may be made, as it will be found sometimes that one tint suits the eye better than another. Some microscopists,

* Chemical News, vol. xx., p. 266. (*Am. Repr., Feb.* 1870, *page* 54.)

instead of tinted glass, use a piece of thin cover-glass, which gives a very good reflection, and can easily be used with this form of setting, which also allows a small right-angled prism to be placed in it, and which, although not usually supplied with the instrument, will be found a serviceable addition. Its use will be described with that of the preceding instruments. This reflector gives a reversed view of the object by a single reflection, as in the steel mirror of Soemmering, but, unlike it, the paper, instead of being viewed round its edge, is seen through the glass.

As these instruments have much in common, the use of them may very conveniently be described together, noticing, in passing, such peculiarities as render them more or less serviceable, each having its own special advantages and defects.

Fig. 40.

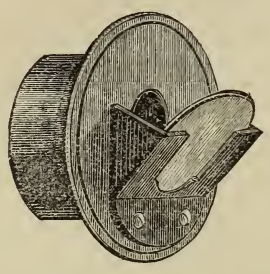
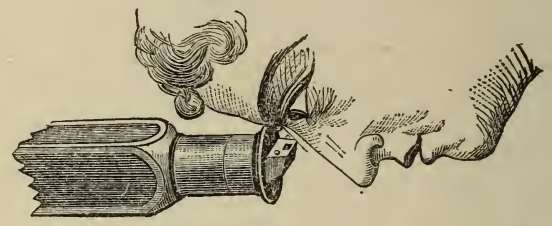
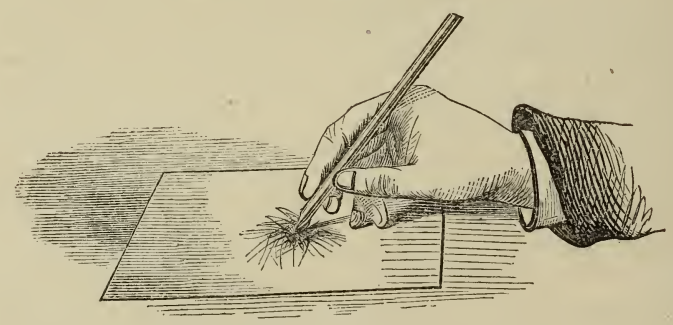


Fig. 41.



The microscope should be placed with the body in a horizontal position (Fig. 41), and, if the stand is not of suitable height, it should be placed on a box or other convenient support. The best distance between the eye and the paper, for general purposes, is 10 inches, this being the standard distance employed in estimating magnifying power; but any other that is convenient may be made use of, bearing in mind that the greater the distance from the eye-piece the larger will be the image; so that the size of the picture is capable of being regulated at will, the only limit being the difficulty of seeing the pencil when too near, and the trouble of drawing with a pencil attached to a long stick if the paper is greatly removed from the usual position.



With respect to the images formed by the several instruments, the camera lucida, as it reflects doubly, has the advantage of giving the image in the same position as when viewed through the microscope directly, which, owing to its perfect internal reflection, is brilliant and well defined. Soemmering's mirror and the tinted-glass reflector reverse the image, just as an ordinary looking-glass. This is of little consequence if only slight outline sketches are required; but, when the drawing is to be highly finished, which is always done by viewing the object directly through the microscope, this reversal becomes excessively troublesome to those who are not, like engravers and lithographers, accustomed to reverse their drawings.

With a view to obviating this inconvenience, the author uses the small right-angled prism before mentioned, when drawing with the neutral tint reflector, which enables the drawing to be completed, as it reverses the image just as the tinted glass; and, as the reflection from the internal surface of the prism is total, the view is nearly as brilliant as that received directly from the microscope.

Only one eye is to be used while drawing, and great care should be taken to maintain its position steadily until the sketch is finished (Fig. 41). With the camera lucida and Soemmering's mirror, the maintenance of this position is somewhat painful, when much prolonged, owing to the divided manner in which the eye receives the light from the object and the paper; and frequently the power of seeing the pencil and drawing is lost after a few minutes' use. With the neutral tint reflector, the view of both object and paper is much easier; and, when the reversal of the picture is immaterial, it is, as far as comfort is concerned, much to be preferred.

The illumination is a matter of great importance in making use of drawing instruments. Care should be taken not to light the object more than is necessary, while it will generally be found advisable to illuminate the paper rather strongly. If the image of the object is too bright, it will be found impossible to see either the pencil-point or the line it is tracing. The camera lucida requires far more care, in this respect, than the tinted mirror.

The author's practice is always, when drawing, to use two lamps; one the little camphine lamp before mentioned (Chemical News, vol. xx., p. 158; *Am.*

Repr. Dec. 1869, *page* 322), which is used exclusively for the microscope; the other a large paraffin lamp, with shade, which lights the paper. By this means, the relative illumination of the object and paper can be very nicely adjusted—a matter of some difficulty when only one lamp is employed.

These instruments are only used to secure an outline, and mark out other main points, the details being filled in by free-hand drawing, which will be found comparatively easy when an accurate outline is obtained to work upon.

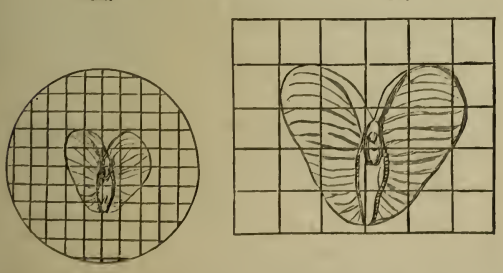
If, when the sketch is finished, before removing the reflector, a ruled micrometer-scale is placed upon the stage of the microscope in the place of the object, the lines can be seen projected upon the paper, just as any other object, and, by tracing some of them, a scale can be formed by which the drawing can readily be measured with a pair of compasses, like a map. This is one of the simplest methods of micrometry.

The magnifying power of the microscope can also easily be ascertained by means of the camera lucida or neutral tint reflector and the stage micrometer. By placing the microscope in the position for drawing, taking care that the eye-piece is 10 inches from the paper, the image of the micrometer-lines, instead of being projected on a sheet of paper, is caused to fall upon a divided scale; and, from the amount covered by it, the magnifying power can be estimated; for instance, the 1-inch objective, with No. 1 eye-piece, causes 0·01 of the micrometer to cover 0·5 inch of the measure on the table; the magnifying power will be 50 diameters. The ½-inch makes 0·01 cover 2·5 inches; the power will be 250 diameters. And so on, for other objectives and eye-pieces.

Finding the placing of the microscope in a horizontal position troublesome, and not liking the constraint of the camera lucida, the author thought that the method of enlarging and reducing drawings commonly employed by artists might be adapted to the microscope. This process consists of ruling a series of squares of convenient size on the drawing to be copied, or placing over it a lattice of threads crossed in squares. The copy is then made upon a sheet of paper or other material, ruled, either in augmented or diminished proportion, as may be required. Messrs. R. and J. Beck ruled a disc of glass in squares (Fig. 42), the side of each of which, for convenience sake, was made to cor-

Fig. 42.

A. B.



respond with 10° of Jackson's eye-piece micrometer. This disc was dropped into the eye-piece, and rested on the stop, so that, when in use, the field appeared similarly divided (Fig 42, A). A sheet of paper (Fig. 42, B), ruled in squares of convenient size, was employed to make the drawing upon; and, by noticing how many squares the object covered, the direction of the various lines, whether, for instance, they ran through the sides or the corners of the squares, and setting them down in similar positions on the ruled sheet, the author found that an accurate drawing might be made with great ease and expedition, and without the trouble of moving the microscope out of the usual inclined position, which is generally the most comfortable for observation. The use of the binocular did not cause any impediment, and the ruled disc only slightly interfered with the definition of the object, and could easily be removed, when its services were no longer required, without disturbing the arrangement of illumination, object, or instrument. When large diagrams are wanted, nothing more is necessary than to use a large sheet of paper, ruled in squares of suitable dimensions, and the object can be rapidly delineated in this augmented proportion.

The measurements can be made either by obtaining the value of the side of a square of the disc with each objective and eye-piece, by means of the stage-micrometer, or by selecting two well-marked dots or lines in the objects, and measuring their distance with the eye-piece micrometer, and using the distance obtained from the corresponding part of the drawing as a standard for the formation of a scale. These processes will be explained in the account shortly to be given of micrometers.

When many sheets of paper are required to be ruled in squares (and it will be found in practice that two or three sizes will be in general request), they can easily be made by placing a perforated sheet over the sheet to be ruled, and rubbing over it a piece of wash-leather dipped in black-lead powder, which will pass through the holes and leave a series of dotted lines on the sheet below, which will be sufficiently distinct, and have the advantage of being rubbed out with a very light touch of the india-rubber, without affecting the pencil-lines of the drawing. The perforated sheets are easily made by means of a comb-like steel punch used by harness-makers, which cuts a row of small pin-holes, equal in length to its own width, which may be an inch or more. This instrument can be obtained at the better class of tool-shops.

Some microscopists have endeavoured, with more or less success, to make drawings from the image of the object projected upon a sheet of paper or ground glass, after the manner of the solar microscope or camera obscura. All the contrivances for this purpose seem to have the defect of giving a very faint image, unless a light of greater intensity than that of ordinary lamps is employed. The image must be received in the dark, which is troublesome, as the outline cannot easily be seen. The process is only applicable to those objects which can be viewed by transmitted light, besides putting the microscope more out of its usual position than the camera lucida and other reflecting instruments.

Intimately connected with microscopical drawing is the subject of micrometry, the practice of the two together forming the records and statistics of histological science. The contrivances used by the earlier observers were rude in the extreme. Leeuwenhoek compares the dimensions of magnified objects with grains of sand. Dr. Hooke, with a little more approach to exactness, used fine silver-wire. By winding a quantity of this closely round a thicker wire, he noticed how many coils there were in an inch, and used the unit so obtained as a means of measurement. The most perfect of the old micrometers is a somewhat

complicated contrivance attached to a microscope by the famous Benjamin Martin, now in the possession of the Royal Microscopical Society. It consists of a separate stage, which is placed on the instrument when measurements are required to be taken. The object is capable of being moved through a definite space, by means of delicate screws, having large graduated heads, upon which the distance traversed by the object can be read off. This micrometer has, in common with all measuring instruments applied to the stage, the defect that any error in the graduation is multiplied by the whole magnifying power of the instrument.

The standards employed in microscopic measurements are the ruled slips of glass before-mentioned. They are graduated by a machine invented by the late George Jackson, and are now to be obtained of most opticians. They are ruled in hundredths and thousandths of an inch, and are marvellously accurate in their divisions, and extremely fine in the engraving of the lines, bearing a very high magnifying power without appearing coarse. Scales are also ruled in millimetres. The millimetre equals 0·03937 English inches, or about 1-25th of an inch. As the metric system will probably in a few years be universally adopted, it is well to place both scales on microscopical drawings, especially as this system of measurement is common on the Continent.

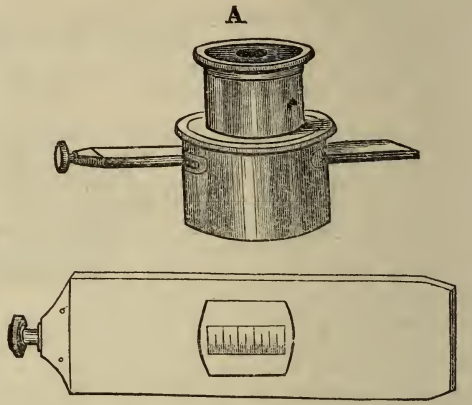
One method of measurement has already been mentioned in describing the use of the camera lucida.

To obtain the greatest degree of accuracy in microscopical measurements, it is desirable that, while the object to be measured is magnified as much as possible, the measuring scale should be but slightly enlarged. This is effected by the use of eye-piece micrometers. The most delicate of these is the well-known *cobweb micrometer* of Ramsden. It is nearly similar to that employed in astronomical instruments, and consists of a positive or Ramsden's eye-piece, in the focus of which is placed a pair of stretched cobweb-lines, one of which is fixed, and the other movable by means of a fine screw which has a large graduated head. The value of the graduations has to be determined for each object-glass, as is the case with all similar contrivances. The cobweb micrometer, when used with a sufficiently high power, is capable of measuring extremely small portions of space with great exactness; the instrument, however, is rather expensive.

With a view to avoid the multiplication of apparatus, the late George Jackson, by a simple contrivance, rendered the ordinary Huyghenian eye-piece available for micrometric purposes. A slit was cut on each side just above the diaphragm (Fig 43, A), which served to admit a brass slide, B, containing a scale ruled on glass, which, when in position, was in the focus of the eye-glass, and could be seen in the field at the same time with the object in the microscope. The scale is ruled with a long line at every fifth division, and a still longer one at every tenth, for facility of reading. The scale is allowed a small amount of lateral motion, which is controlled by a fine screw acting against a spring on the opposite side. This movement enables the line from which the measurement commences to be brought to the edge of the object more accurately than it could be by means of the stage movements, as the scale of the eye-piece micrometer is only magnified by the trifling power of the eye-glass, while the motion of the stage-racks is enlarged by the whole power of the instrument. The operation of measuring is nearly as easy as applying an ordinary rule: the scale is brought over the object, adjusted by the screw, and the number o degrees read off in the direction required.

Fig. 43.

A



B

To determine the value of the degrees, which differs with each objective, the following process must be adopted:—

Place the micrometer in its eye-piece, and focus, if necessary, for distinct vision of the scale by unscrewing the eye-glass, which is usually provided with a rather long screw for this purpose. Screw on the objective, and place the ruled scale on the stage; and, looking through the microscope, focus until the lines are sharp and distinct. Suppose the value of the micrometer is to be ascertained for the $\frac{2}{3}$ object-glass, and it is found that 1-1000th of an inch of the ruled scale on the stage occupies a little less than two divisions of the micrometer, this will give an awkward number for calculation; so it will be necessary to increase the power of the microscope to such an extent that the 1-1000th should occupy 2° exactly. This can be done by lengthening the body by means of the draw-tube, which, for this purpose, should be divided into inches and tenths, that the amount of extension may be noted. The tube is to be drawn out until the divisions of the stage micrometer coincide with those of the eye-piece micrometer. Say, for example, it is found that, to effect this, the tube has to be lengthened 3-10ths of an inch; then, as 1-1000th of an inch equals 2° of the eye-piece micrometer, 1° is equal to 1-2000th of an inch. This process should be repeated with each object-glass, and tried several times to ensure accuracy. The result should be preserved in the following tabular form:—

Value of Divisions of Eye-Piece Micrometer.

Objective.	Draw-tube.	Vulgar Fraction.	Decimal.
$1\frac{1}{2}$	13	$\frac{1}{1000}$	·001
$\frac{2}{3}$	3	$\frac{1}{2000}$	·0005
$\frac{1}{10}$	22	$\frac{1}{4000}$	·00025

And so on through the whole series of objectives. The slight alteration of distance between the anterior combination and the back lenses caused by turning the graduated collar which regulates the adjustment for covering glass with the higher powers, slightly alters the magnifying power; and, when very accurate measurements are required, the draw-tube correction must be ascertained for each degree of the adjustment-

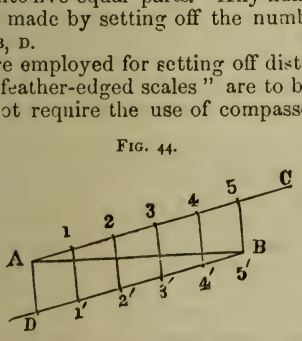
collar. The value of the divisions of the Ramsden's or cobweb micrometer is calculated in the same manner. When this table is once made, measurement with the eye-piece micrometer becomes very easy indeed. After selecting the object-glass and placing the micrometer in the eye-piece, draw out the tube. The number of tenths indicated in the table, and then the degrees, can be read off just like an ordinary measure. To secure accuracy in measuring, always use the highest convenient magnifying power, as the readings can be made with greater minuteness; for instance, a degree with the 4-10th or $\frac{1}{2}$ equals 1-4000th of an inch; while, with the $\frac{1}{8}$, it would be 1-16000th, and half a degree can easily be estimated by the eye; so, by using the higher power, 1-32000th of an inch can easily be measured, and greater minuteness still can be obtained by using higher powers, where practicable.

A convenient mode of measurement has been devised by Dr. J. Matthews. It is an adaptation of the indicator, sometimes placed in the eye-piece to mark a spot in the field. Two of these pointing needles, suitably curved so that they act, by means of milled-heads, like a small pair of callipers, are placed as just mentioned. The distance on the object is measured between these points, and, upon the removal of the slide, the value of the space can be estimated by putting the stage micrometer in its place. For counting striæ and other marks in a given space, and for many purposes, this simple contrivance is very effective, as, also, where the glass of the stage micrometer might interfere with the definition of a very delicate object.

In making the scales on microscopical drawings, it is often necessary to divide a given space into a certain number of equal parts. When the number is a multiple of two, it is readily performed by a continued process of bisection; but, as ten is a number frequently required, this process will not serve beyond the first bisection, which leaves five—a rather troublesome number to guess at with the compasses. Suppose the line A, B (Fig. 44) is to be divided into five parts. From A, rule the line A, C at any convenient angle, of any suitable length; from B, rule B, D parallel to A, C; from A, set off, with the compasses, five equal spaces (1, 2, &c.) towards C; and, from B, set off the same towards D; join 1, 1′; 2, 2′; 3, 3′, &c.; and the lines 1, 1′, &c., will divide A, B into five equal parts. Any number of divisions may be made by setting off the number required on A, C and B, D.

If scales are employed for setting off distances, those known as "feather-edged scales" are to be preferred, as they do not require the use of compasses, the divi-

Fig. 44.



sions being marked directly on the paper from the thin edges. For general purposes, that known as a builder's scale is convenient, as it contains a large number of different scales, all of which are ingeniously contrived to read at the edges. It should, however, have the sub-divisions in tenths, and not, as usually made, in twelfths. A millimetre scale will also be found useful.

(To be continued.)

ON A MINERAL FROM SAN PAOLO.

BY DR. T. L. PHIPSON, F.C.S.,

MEMBER OF THE CHEMICAL SOCIETY OF PARIS.

A mineral from San Paolo, Brazil, was placed in my hands a short time ago in Paris; it was supposed to be a silicate of yttria, and was called Thelline or Thelite. It corresponded in appearance and properties with the silicate of yttria, described by M. Damour, in 1858, as having been found in the diamond sands of Bahia, Brazil; a brown mineral, said to be "probably a silicate of yttria," which whitens before the blowpipe, but does not fuse, and was found to be insoluble in phosphorus-salt.

A small sample of the specimen from San Paolo was confided to me for analysis, with a request that I would make known the result at an early opportunity.

The following is a description of the mineral and its analysis:—It is of a light brown colour, translucent on the thin edges, and in the veins which traverse its substance; when pulverised it gives a light yellow powder of great brilliancy, which becomes bright red when heated; it is partially attacked by strong acids. Before the blowpipe it is infusible, but darkens and turns black in the inner flame, and, by continuing the heat for some time, the surface becomes quite white. It scratches glass like a diamond, and cuts it very nearly as easily as the latter, but it will not attack quartz; it gives flashes and sparks of fire when struck smartly in an agate mortar; it is quite devoid of crystallisation, and its fracture is imperfectly conchoidal. No trace of yttria could be obtained from this mineral, but it was found to contain about 1 per cent of glucina as an accidental constituent. It yielded—

Silicic acid	90·90
Water	4·54
Peroxide of iron and alumina with about 1 per cent of glucina	4·56
	100·00

The presence of glucina in this mineral, which is evidently a kind of hydrated silica, menilite, or resinite, is rather interesting, and leads me to believe that this earth will be found in other natural kinds of silica. Silicate of glucina (Phenakite) is so closely allied to quartz in appearance and crystalline form that it is easily mistaken for it, and substances possessing, when crystallised, the same crystalline form are often found together in nature. I do not conclude from the above that the mineral I have examined is identical with M. Damour's silicate of yttria, for I am not aware that I have ever seen the latter. Doubtless he will some day publish an analysis of it.

Analytical Laboratory, Putney, S.W.

BEET-ROOT SUGAR.

When the Berlin apothecary, Marggraf, in the year 1747 made known, at a meeting of the Royal Prussian Academy of Sciences, the fact that the beet-root contained sugar identical with that derived from sugar-cane, and that he had obtained, by means of alcohol, 6·2 per cent of sugar from the white variety of beet, and 4·5 per cent from the red-coloured root, he certainly did not dream that, within a century after his discovery, the manufacture of beet-root sugar would have become one of the

[English Edition, Vol. XXI., No. 531, page 39; No. 529, page 13.]

most extensive of what is very properly termed, in the German language, *landwirthschaftliche Gewerbe*, but for which no very good translation can be given. It is too much the fashion to take it for granted that manufacturing industry ought to be chiefly confined to larger centres of population; but this notion is not entertained on the Continent, where, beside beet-root sugar making, the preparation of madder and various derivatives therefrom is conducted in the country, rather than in towns. This is also the case with the distillation of spirits from wine, as well as that obtained from various other sources—viz., potatoes, beet-roots, cherries, &c.

The proposals made by M. Marggraf to obtain sugar from beet-roots on the large scale did not then meet with any success, owing to a variety of concurrent causes, among which may be mentioned the cheapness of cane-sugar, imported into Germany from this country and Holland. About the end of last century, Messrs. Achard and Hermbstädt again called attention to this subject, and succeeded on a sufficiently large scale in obtaining from beet-roots about 6 per cent of crystallised sugar and 4 per cent of molasses. It was, however, mainly due to the political disturbances and wars of the latter end of the last and the first fifteen years of the present century that the manufacture of beet-root sugar was entered into commercially. This was principally due to the encouragement of Napoleon I., aided by the eminent judgment and sound scientific knowledge of one of his ministers—the famous Chaptal. It is true that, almost immediately after Napoleon's fall, the beet-root sugar industry collapsed—but only to be revived on sounder scientific and mercantile principles, its temporary collapse being partly due to the protective tariffs made in favour of colonial sugars; whilst, in some countries, beet-root sugar making was practically prohibited, also, by absurd and injudicious excise regulations.

The plant known as *Beta maritima* (an unsightly biannual vegetable, which grows wild on the coast of the Mediterranean in Spain, Dalmatia, and some parts of France) is the mother plant from which the sugar-yielding beet has been derived. The well-known red beet is a different variety of the same genus. The beet has been an object of regular cultivation as a suitable cattle-fodder only from the beginning of this century, since which time several varieties have been obtained, partly as a result of cultivation, partly, also, as a consequence of climate and soil. The *Beta cicla*, or so-called white Silesian beet-root, is considered by many as the best variety for the production of sugar. This root, as well as the other varieties, is a biannual plant. The first year after sowing it only produces rootlets and leaves; in the second year of its growth, the root becomes developed; and, were it not that this vegetable cannot very well stand frost, the best period for its gathering would be in the spring following its second winter. This condition, however, cannot be complied with, and the crop is gathered in the autumn. The weight of the crop of roots gathered from one hectare varies, as might be expected, considerably; but the following figures may give some idea of this subject:—In Austria, from 416 to 580 cwts., yielding from 3080 to 4336 lbs. of sugar; Bohemia, from 448 to 580 cwts., yielding from 3344 to 4640 lbs. of sugar; Prussia, about 720 cwts., yielding about 5344 lbs. of sugar; France, 596 cwts., yielding 4464 lbs. of sugar. The composition of a good kind of the *Beta cicla*, in 100 parts, is:—Water, 83·5; sugar, with a trace of dextrine (about 0·1), 10·5; ligneous fibre, 0·8; albumen, casein, and other albuminoid substances, 1·5; fatty matter, 0·1; organic substances—viz., pectine, citric, and pectic acids, a substance which, in contact with air, assumes a rose colour, asparagin, oxalates and pectinates of lime, potassa, and soda; inorganic salts—viz., nitrate and sulphate of potassa, chloride of potassium, phosphate of lime, and magnesia, all together, 3·7 per cent. It is evident that the juice obtained from a plant of that complex composition is a somewhat difficult fluid to deal with for obtaining sugar therefrom; and, in order fully to illustrate the triumph of well-applied science in this respect, we quote, for comparison's sake, the percentage composition of sugar-cane:—Sugar, 17·8; water, 72·0; cellulose, 9·8; saline matter, 0·4.

There are various processes in use for obtaining sugar from beet-root; but the following is an outline of the general mode of operating:—The roots are dug up, and the head bearing the leaves (which serve together as fodder) is cut off commonly on the field. The roots are then carted to the sugar works and there washed by machinery, it being essential that neither clay nor pebbles should remain adhering, since these might injure the machinery by which the roots are next made into pulp, by being torn up by very sharp circular saws, placed close together on a revolving cylinder, making from 1000 to 1200 revolutions per minute. The pulp is placed in bags made of a very strong linen tissue, and from twenty-five to fifty of these bags are placed on each other on the movable plate of a hydraulic press, care being taken to place between every two bags a frame wicker-work or perforated tinned-iron plates. The pressure which can be applied averages from 500 to 700 lbs. per square inch; generally the pressing process is repeated, sometimes with, sometimes without previous moistening of the cake, which, in some cases, is also broken up again. Before we follow the juice obtained by this pressure, we may pay a moment's attention to the cake obtained after it has been submitted to repeated pressure. It exhibits a hard, somewhat plank-like appearance, varying in size with the size of the press-plate, and about $\frac{1}{2}$ or $\frac{5}{8}$ of an inch thickness. It contains, according to an analysis made at Hohenheim*:—Water, 15·61; ash, 1·27; cellulose, 1·47; sugar, 1·72; carbohydrates (starch, &c.), 2·84; proteine compounds, 0·28: together, 23·2. To which add, to make up the 100 parts of beet-root, 76·8 per cent of juice, containing:—Water, 65·95; sugar, 10·17; carbohydrates, 0·63; proteine compounds, 0·58. The cake is used as fodder for cattle, or, in some cases, for the manufacture of brandy, vinegar, and, last, but not least, for the manufacture of paper, for which it is increasingly in demand.

The juice, as it runs from the press-plate, is led, by means of gutters, to what is termed a *monte-jus*, and by its means (by steam) forced up to the defecation-pan, wherein it is rapidly heated, by means of steam (the pan being jacketed), to 85°. This temperature having been reached, a thin milk of lime is added, and the fluid thoroughly stirred up. The lime saturates the free acid present in the juice, and precipitates as well as decomposes the albuminous substances, ammonia being consequently evolved. In order that the lime should act properly, it is necessary to increase the heat, which is

* This place is situated near Stüttgart, in Wurtemberg, and is one of the largest and the best conducted agricultural colleges in Europe. It is fitted up, not only for theoretical, but also for practical instruction, and contains a model beet-root sugar work, brewery, distillery, and other manufactories belonging to the class termed, in Germany, *Landwirthschaftliche Gewerbe*, on a sufficiently large scale for practical use.

raised to near the boiling point of the fluid. The quantity of lime added depends upon the quality of the roots, but is generally about from 1 to 2 lbs. for every 100 litres of juice. The liquor in the defecation-pan is run off clear from the supernatant scum, by means of an ingeniously-contrived tap, and, previous to reaching the animal charcoal filters, the fluid is filtered through a peculiar kind of flannel, made on purpose. The defecated juice is not a pure solution of sugar; it contains saccharate of lime, free sugar, free potassa, soda, and some ammonia; small quantities of organic nitrogenous substances, and sulphate and nitrate of potassa. The removal of a portion of these impurities is effected, in many instances, by filtration through animal charcoal, next submitted to the action of a current of carbonic acid, whereby the saccharate of lime is decomposed; and the clear liquid is evaporated to a density of 24° to 25° Beaumé (sp. gr., 1·199 to 1·210), and again filtered over animal charcoal, in order to remove from the liquid (technically, *clearsel*) colouring matter and other impurities. The filtered juice should have the colour of pale Sherry, and be free from any suspended impurities. The filtered liquor is next evaporated to a density of about 42° Beaumé (sp. gr., 1·412). This evaporation is best performed in a vacuum-pan. When the proper degree of concentration has been attained, the thickish magma (a mixture of crystallised sugar and syrup or molasses) is run into a copper pan, technically termed a cooler; but this is in so far a misnomer, as the contents of the pan are heated by steam to a higher temperature (above 120°) than was attained in the vacuum pan. The contents of the pan are kept in constant motion, by means of stirring, while a gang of men are busy carrying the pasty mass to the sugar-loaf forms, in order therein to solidify, and to be deprived of adhering syrup by being washed with a solution of pure sugar, sufficiently concentrated for it not to dissolve any crystallisable sugar, while effectually removing the molasses. Instead of this rather expensive process, which yields refined sugar, it is often omitted, and in its stead is substituted the use of the centrifugal machine, or, also, of the so-called Schutzenbach boxes (iron tanks, with a false bottom made of wire-gauze, upon which the magma, after it has been heated in the coolers, is run), and there left for several days, until the molasses have entirely run off; the produce being raw beet-root sugar, which is not fit for consumption until it has been refined, even if its colour is only pale yellow.

The molasses from beet-root sugar are unfit for use as sweetenings, owing to the large quantity of mineral salts they contain. According to Meitzendorf, these molasses consist, in 100 parts, of:—Water, 10·8; mineral salts, 10·5: proteine compounds, 9·8; sugar (cane-sugar and non-crystallisable sugar), pectin, fatty matter, caramel, and other undetermined organic substances, 68·9. This material is employed for the manufacture of spirits, which, however, are not at all agreeable to the palate, but might be rendered pure by re-distillation with quick-lime and the use of freshly-ignited wood-charcoal. The residue of this distillation is a valuable source of potash. In Russia and some parts of Silesia the molasses are used, along with other fodder, for the cattle—a practice which deserves encouragement.

The Continent of Europe contains 1184 beet-root sugar works situated in Germany, France, Russia (inclusive of Poland), Austria, and Belgium. There are, perhaps, scattered over the rest of Europe, some dozen of these works yet; but their production does not materially add to the 4,475,000 cwts. of beet-root sugar annually produced by the works above named. It is evident that, in countries where labour is cheap, and whose inhabitants, but for the beet-root, would be dependent for their supply of sugar upon countries which possess colonies, or dependencies where sugar-cane can be grown, the cultivation of beet-roots intended for the manufacture of sugar is a decided boon. In some cases, objection may be raised to this industry, since it cannot be denied that the extensive culture of such crops as, for instance, beet-root, tobacco, madder, &c., may interfere, to some extent, with the cultivation of cereals. Yet, however cogent this objection (which has, also, been several times brought forward against the extensive cultivation of sugar-cane in hot climates), it is an undeniable fact that the rural populations in Europe derive great benefit from this industry, which keeps them suitably employed during the winter months of each year; and the results obtained fully prove that beet-root sugar can hold its ground, and compete successfully with colonial sugar when placed on equality therewith.

As regards the United Kingdom, it cannot but cause some astonishment, that a country ranking first in agriculture, and doubly so in everything relating to manufacturing industry, should have hitherto lagged behind in the successful carrying out of this industry—a fact the more to be wondered at since the cultivation of root crops is very extensively carried on, and the beet-root residues may serve as food for cattle even better than the roots purposely cultivated for that purpose. Agricultural labourers can (as instanced by Continental experience) be readily taught the operations of the beet-sugar manufacture; and the skilled supervision does not require more than, at the utmost, half-a-dozen men. In France, Belgium, and Germany, women, as well as men, are employed in these works. As to climate, excepting the central and northern parts of Scotland, and the high moor grounds, the United Kingdom is as favorably situated for the cultivation of beet-root for sugar manufacture as any portion of the European Continent; while the higher standard of agricultural efficiency in this country would greatly tend to secure good crops with existing system of rotation. As regards the duty on sugar, this is now equalised with that payable in the neighbouring countries—France, Belgium, and the Netherlands. So that, if this matter were to be properly taken up, and economically carried out, with due foresight, and there were brought to bear upon it that practical scientific knowledge which has raised, on the Continent, this industry from a puny infancy to the full strength of vigorous manhood, there is no doubt that it may become a source of great improvement and well-being to the rural population of this country.

ON THE

MANUFACTURE OF CRUCIBLE STEEL.

BY R. H. SMITH, F.C.S., ETC.

A GREAT deal is being talked about the production of cast-steel directly from iron ores, or its manufacture from inferior kinds of English iron; but little is known or said (outside the immediate manufacturing districts) as to how the immense quantities of this substance are produced at the present time. The conversion of iron into steel is, perhaps, to be classed among one of the most peculiar, but, at the same time, interesting, processes with which chemists are acquainted.

The ordinary converting furnaces are of a conical shape, the bar-iron laying in stone pots, in contact with charcoal; and the heat to which the iron is exposed is regulated according to the purpose for which it may afterwards be required. The time generally occupied in what is termed "conversion" is about three weeks, a week being taken to raise the heat to a sufficient degree, a second to maintain it at the required temperature, and a third to gradually cool the furnace. When cold, the bars are withdrawn, and found to be covered with blisters, and, if broken, possessing a fracture totally different in appearance to that shown by the iron before treated in the manner described. Several tempers, as they are technically called, are produced in one furnace, and much care is necessary in selecting them out for the different requirements of the melter.

Too much care cannot be taken in the melting of steel, as the after work so much depends upon this part of the process. The melting holes are on a level with the floor of the furnace-room. Each hole has a flue; and some six, twelve, or more, of these form a flat stack. The grate bars at the bottom of each hole are approached by means of a cellar below. The crucibles, or pots, as they are called, made from a mixture of several kinds of clay and a little coke-dust, are formed into shape by means of a plug and flask. The pots are annealed over night, and, when at a dull-red heat in the morning, placed in the holes by means of tongs, each furnace taking two pots.

The bar-steel of the required hardness is now broken up, and the crucible charged by means of an iron funnel. The first heat, as it is called, will take from four to five hours before it is ready to be poured; but this greatly depends on the nature and hardness of the steel. The holes are watched and worked by the puller-out; but the word to draw the pot is given by the melter.

The puller out now lifts the crucible from the hole with large tongs, and places it upon the floor of the furnace. Its contents are then poured by the melter into a mould, made of cast iron in two pieces, covered with a coat of coal-tar soot, and held together by rings and wedges.

Great care is required in pouring, or teaming, the steel, as it is technically called, and skill in judging the proper heat when to cast it. Mild or soft steel should be teamed immediately the pot is withdrawn from the furnace; but hard steel may often remain a few minutes with advantage. Each crucible should last one day, and is used three times with charges of 50, 45, and 40 lbs. respectively.

All steel above a chisel temper contains 0·90 to 1·00 per cent of carbon. If well melted it will settle down in the mould, leaving a small hole at the top of the ingot. If, however, the molten steel has not remained long enough in the fire, it will pour fiery; and, if the ingot, on cooling, be broken, it will be found to be full of small holes, called honeycombs. Great precaution must also be used in not allowing the metal to remain too long in the fire, as hard steel, when of good quality, will soon scorch, and so render the ingot very brittle.

Well melted steel (say of a tool temper) may be thus known. The ingot will be of a blue colour, with a smooth and even skin; the fracture of uniform brightness, and the outer edge perhaps slightly scorched.

Another very important operation to which steel is subject is the hammering; and probably more good steel is spoiled in this department than any other. The ingot should be well soaked in the flame of the forge-furnace, and not at once (as is often the case) put into a dead fire—where the heat is what is called "dead," and where no flame surrounds the ingot.

The fineness of the fracture of a bar of finished steel greatly depends upon the heat that the bar is allowed to retain when the finishing stroke of the hammer is upon it. Coarseness and fineness of grain, as judging the temper or quality of cast-steel, is far over-estimated. It is, to a certain extent, an indication of hardness; but so much depends upon the way the bar has been finished, that it is of little practical value. However, best cast-steel, especially when hard, will show a fracture of a silky nature; and, when soft, will look bright, and shine like glass. Common cast-steel, on the other hand, will lack that brightness which is so characteristic of good steel; it will look dull, and have, so to speak, a leaden appearance about it.

In the working of steel, too much care cannot be bestowed; and, where (as in razor making) the workman is required to use a steel containing about 1·50 per cent of carbon, the durability of the razor will almost entirely depend upon the heat to which he subjects it while forging it into shape.

A useful "tool-steel" will contain about 1·2 to 1·35 per cent of carbon. Spindle-steel, or large size turning tools, will work well if containing about 1·15 per cent of carbon. Chisel-steel is a temper much used, will harden at a low heat, and possesses great toughness. Steel of 0·85 to 0·75 per cent of carbon will weld easily, and is adapted for "cold setts," or tools where the principal punishment is on the unhardened part.

In melting, charcoal is largely used when the bar-steel is not of the required hardness. Wolfram and titanium are occasionally used, but with little advantage.

Binoxide of manganese is universally employed. It forms a good flux, and protects the molten-steel from the action of the air.

Spiegeleisen is much used in Sheffield. It is an alloy of iron with manganese and carbon. The following is an analysis of a good spiegeleisen:—

Iron (by difference)	84·78
Manganese	10·21
Carbon	5·01
	100·00

Among the many irons employed in steel-making, none have acquired the reputation that those imported from Sweden have won for themselves, and especially those known as the Dannemora marks.

Such brands as Double Bullet (OO) and hoop L (L) command a high price, and are much used where the best quality steel is required. Second Swedes, such as Wand Crown, Steinbuck, Great S, K6, &c., are good bodied irons, largely employed, and making a very good steel. Of the commoner marks may be quoted (CW) (SV8) Spider, and $\overset{\frown}{\text{IG}}$; and where a high price cannot be obtained for the steel, such brands are recommended, being found to melt and work well. English irons and spring ends are also melted, but make an inferior quality of cast-steel.

The following is an analysis of tool-steel:—

Iron (by difference)	88·34
Carbon	1·31
Manganese	0 12
Silicon	0·19
Sulphur	0·03
Phosphorus	0·01
	100·00

ON THE

TESTING OF MANGANESE ORES.

BY BENJAMIN H. PAUL, PH.D.

The question raised by Sherer and Rumpf * as to the practice of representing the value of manganese ores by the amount of binoxide of manganese actually contained in them, or equivalent to the other peroxides of manganese which are sometimes present in such ores, is one that will, no doubt, attract the notice of chemical manufacturers. And the suggestion that the value of manganese ores should be measured by chlorometrical degrees, rather than by the actual percentage of binoxide, has a tendency in the same direction as the resolution † passed by the Association of Alkali Manufacturers, last year, in reference to this subject.

The decision then adopted by the Association would seem to have been based more upon differences found, in practice, to exist between working results and the indications of tests made for determining the percentage of manganese binoxide in sample, rather than upon any probable or ascertained cause of variation in the results obtained by the method of Fresenius and Will. It would seem, also, to indicate a desire on the part of manufacturers that tests of manganese ore should express the amount of binoxide *available* for liberating chlorine, and not the amount *actually* present in the ores. It is in this respect that the iron method has an advantage over the method of Fresenius and Will, since the presence of iron as metal or protoxide in manganese ore would affect its power of liberating chlorine. The result of a test of such manganese ore by the iron method would be correspondingly affected; but that would not be the case if the method of Fresenius and Will were adopted in the testing.

Much of the discrepancy between the results of tests of manganese ore, and many of the disputes that have arisen as to the percentage of these ores, may, in all probability, have been due to the circumstance mentioned above; and, to provide against a recurrence of such differences, it would seem desirable that, in regard to a certain class of manganese ores, some other mode of testing than that of Fresenius and Will should be agreed upon, so that the valuation of those ores may be based upon the available binoxide, and not upon the actual amount.

That form of the iron process in which chloride of iron is used does not appear to be suitable for this purpose, on account of the possible loss of chlorine which may take place in the operation; but Bunsen's method of dissolving the ore with hydrochloric acid, passing the liberated chlorine into iodide of potassium solution, and determining the iodine liberated, would probably answer the purpose.

However, there is reason to believe that Sherer and Rumpf have overlooked another circumstance which must be considered in regard to the method of Fresenius and Will. With certain limitations, there is little doubt that this method gives results which are uniform, especially if the manganese ore tested in that way is of German origin, or if it resembles the German ore in being soft and readily soluble; but many varieties of manganese ore now in use are not of that kind. The Spanish, Nova Scotian, and Californian ores, for instance, are often excessively hard, and, even when finely powdered, difficult to dissolve thoroughly. In testing such ores by the method of Fresenius and Will, there is, in the first place, a risk of incomplete solution, which would make the result too low. If heat be applied to the apparatus in order to render solution complete, there is, in the second place, a risk of driving off water, which would make the result too high.

In some instances, the differences that have obtained between the results of tests could not be referred to the presence of iron as metal or protoxide in the ores, inasmuch as Fresenius and Will's method has, in those cases, been used by the several operators, and it is probable that those differences arose from the difficult solubility of the ore. But, however that may be, it seems no longer admissible to use that method for testing manganese ores generally, although there is no reason to doubt the uniformity of its results when applied to the soft kind of ores formerly in use almost exclusively.

For these reasons, and on account of the long time requisite for dissolving manganese ores of this kind, the method of Fresenius and Will is not well adapted for testing them. For some time past, therefore, I have adopted Mohr's method of using a known quantity of a standard solution of oxalic acid, together with excess of sulphuric acid, for dissolving the ore; if necessary boiling until the ore is completely dissolved, and then, by means of a standard solution of permanganate, determining the quantity of oxalic acid remaining undecomposed. This method is very convenient for testing manganese ores, and since it involves only one weighing for each test, the source of error is less than in the method of Fresenius and Will. The results obtained are also very uniform.

This method has also the advantage of giving results which fairly represent the amount of available binoxide in manganese ores; for any iron that may be present as metal or protoxide would consume an equivalent quantity of permanganate solution, and thus apparently reduce the quantity of oxalic acid decomposed by the binoxide to an extent proportionate to the amount of iron existing in the ore. Thus, for instance, if the quantity of oxalic acid decomposed by 100 grains of manganese ore free from iron or protoxide of iron were 109·53 grains, the ore would contain 76·5 per cent binoxide, and the whole of that would be available. But, if the 100 grains of ore also contained 5·6 grains of metallic iron, or an equivalent of protoxide, the permanganate solution required for peroxidising that iron would represent 6·3 grains of oxalic acid, and the quantity of oxalic acid decomposed by the binoxide would appear so much less than it really was, or 103·23 grains instead of 109·53 grains. Accordingly, the amount of binoxide would be repre-

* Chemical News, vol. xx., p. 302; *Am. Rep. Feb.* 1870, *page* 82.

† "That, as the testing of manganese according to the method of Will and Fresenius is, in the opinion of the meeting, incorrect, and yields uncertain results, it is recommended to members of this Association not to buy by that test."

sented as 72·1 per cent, instead of 76·5 per cent; and that would, in fact, be the amount of binoxide available for generating chlorine.

This method of testing recommends itself by its simplicity, and by the fact that the standard solutions of oxalic acid and permanganate will keep for a long time without alteration of value.

The oxalic acid solution contains 63 grms. in the litre, and 1 c.c. is equivalent to 5 c.c. of the permanganate solution.

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ON THE

SIMULTANEOUS OCCURRENCE OF A SOLUBLE LEAD SALT

AND

FREE SULPHURIC ACID IN SHERRY WINE;

WITH OBSERVATIONS ON THE SOLVENT ACTION OF ALCOHOLIC SALINE SOLUTIONS UPON SULPHATE OF LEAD.*

BY PROFESSOR F. H. STORER.

Several years since, I was called upon by a wine merchant of this city to examine a sample of pale sherry taken from a cask which had been returned to him, on the certificate of a chemist that the wine contained lead. The sample in question was perfectly transparent and clear. There was nothing in the appearance or taste of the wine to indicate the sophistication to which it had really been subjected.

On submitting this sherry to chemical analysis, I found not only that it held in solution a considerable proportion of lead, but also a decided trace of free sulphuric acid, besides an abundance of the same acid combined with some alkaline base. When a portion of the wine was evaporated in contact with slips of paper, the latter soon became crumbly and friable.

Regarded merely from the chemical point of view, without reference to its manifest bearing upon questions of hygiene and jurisprudence, the simultaneous occurrence of a lead salt and of free sulphuric acid in alcoholic solution is a fact sufficiently important to merit close attention. Unfortunately, the small sample of wine given me was completely exhausted in the severe confirmatory tests by which the results above mentioned were controlled, and I have had no opportunity to determine the precise manner in which the lead was held in solution in that particular case. Several conjectures as to the cause of the phenomenon will be discussed below.

That lead compounds should still be employed in the treatment of wine will surprise no one familiar with the tenacity with which traditions are held by successive generations of operatives in many of the chemical arts. According to Taylor,† "litharge was formerly much used to remove the acidity of sour wine and convey a sweet taste. Acetate of lead, or some other vegetable salt of the metal, is in these cases formed; and the use of such wine may be productive of alarming symptoms. Many years since a fatal epidemic colic prevailed in Paris owing to this cause; . . . . the adulteration was discovered by Fourcroy, and was immediately suppressed."

Beckmann in his "History of Inventions"‡ dwells at some length on the antiquity and enduring character of the practice of neutralising the acid which spoils wine by means of litharge. According to this author, the practice was forbidden by legal enactment in France as early as 1696, but a hundred years later "the art of improving wine by litharge was taught in England as a method perfectly free from danger." *

The sulphuric acid in the sample of wine examined by me was probably added, with a view of removing the dissolved lead resulting from the previous use of litharge. It is not unlikely that the addition of the free acid was preceded by that of a solution of sulphate of ammonium.

In seeking for an explanation of the fact that a certain proportion of lead may remain dissolved in wine, even in presence of free sulphuric acid, the following hypotheses suggest themselves:—

1st. It seemed not impossible, in case a mixture of weak alcohol, dilute sulphuric acid, and sulphate of lead was left to itself for a long time, that a part of the lead salt might be changed to sulphovinate of lead and pass into solution. This idea was sufficiently improbable in view of the known facts that dilute alcohol and weak sulphuric acid are unfit for making sulphovinic acid, and that but little, if any, of the acid can be formed even from tolerably concentrated liquids, unless the mixture of alcohol and sulphuric acid be heated artificially. The idea was, nevertheless, put to the test of experiment, as follows:—

100 c.c. of alcohol of 59 per cent, 5 c.c. of oil of vitriol, and a quantity of recently precipitated sulphate of lead were placed in a stoppered bottle, and the mixture was frequently shaken during an interval of three months. The clear liquid was then decanted, diluted with water, and saturated with sulphuretted hydrogen gas. Not the slightest colouration indicative of lead was produced.

100 c.c. of similar alcohol, mixed with sulphuric acid, sulphovinic acid, and sulphate of lead, gave no reaction for lead when tested after the lapse of three months.

2nd. Though the idea seemed highly improbable, it was still possible that the sugar in the wine might in some way exert a solvent action upon sulphate of lead. It was found, however, when 100 c.c. of alcohol of 59 per cent and 5 c.c. of oil of vitriol, together with a quantity of sugar and of precipitated sulphate of lead, were left to themselves for three months, that the clear supernatant liquid held no trace of lead in solution. For that matter, it was found that a mixture of sulphuric acid and much sugar-water was capable of precipitating all the lead even from an aqueous solution of acetate of lead. The filtrate from the sulphate of lead thus precipitated gave absolutely no indication of lead when tested with sulphuretted hydrogen, not even when a considerable quantity of the liquid was evaporated to dryness, incinerated, treated with nitric acid, and again evaporated before applying the reagent.

3rd. The most probable hypothesis of all, however, was, that a certain proportion of lead could be held dissolved in presence of sulphuric acid, even in an alcoholic solution like wine, by the action of various soluble alkaline salts capable of decomposing and of being decomposed by sulphate of lead; for it is a well-known fact that very considerable quantities of sulphate of lead can be held dissolved in water by means of many acetates, citrates, and tartrates, and by various other salts.

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* Communicated by the Author.
† "On Poisons," p. 502 of the London edition.
‡ "Chapter on Adulteration of Wine."

* William Graham's "Art of Making Wines from Fruit, Flowers, and Herbs." London, sixth edition.

To test this idea, the following set of experiments has been carried out at my suggestion by Mr. A. H. Pearson, of Haverhill, a student in the Laboratory of the Massachusetts Institute of Technology.

A considerable quantity of dilute alcohol, of the usual strength of sherry wine (18 per cent), having been prepared, standard solutions of acetate of lead, of sulphuric acid, and of sulphate of ammonium were made by dissolving weighed quantities of these substances in portions of the 18 per cent alcohol. Each of the solutions was made of such strength that 500 c.c. of the liquid contained one-tenth of an equivalent of the salt or acid, reckoned in grammes, on the hydrogen scale.

Alcoholic solutions of several salts of ammonium and of the fixed alkalies were also prepared, as will be described below.

In each experiment, equal quantities of the standard solution of sulphuric acid, or of sulphate of ammonium, and of the saline solution to be tested were mixed in a glass flask, and the standard solution of acetate of lead was made to fall from a burette drop by drop into the mixture until a persistent precipitate of sulphate of lead was perceived. The burette was graduated so that two drops from it were equal to one-tenth of a cubic centimetre; and the flask was constantly shaken while the drops of acetate of lead were falling into it.

The results of the experiments are as follows:—

Acetate of Ammonium was prepared by neutralising ordinary acetic acid with ammonia-water, and the strong aqueous solution thus obtained was mixed with alcohol. It appeared, however, that this alcoholic solution of the acetate exerted no solvent action upon sulphate of lead, for a permanent precipitate of the latter was produced in the mixture of acetate of ammonium and normal sulphuric acid by the first drop of the standard solution of acetate of lead. The same negative result was obtained in several repetitions of the experiment, even when new portions of dilute alcohol and a second set of the standard solutions were employed.

When, however, the solution of acetate of ammonium was mixed with an equal bulk (10 c.c.) of the standard solution of sulphate of ammonium, instead of the sulphuric acid, a considerable quantity of sulphate of lead was held in solution by it. In two distinct trials, the precipitate formed by dropping acetate of lead into the mixed solution of acetate and sulphate of ammonium, continued to re-dissolve until 3 c.c. of the standard solution of acetate of lead had been added to the liquor. These 3 c.c. of the standard solution contained 0·1137 grm. of acetate of lead, corresponding to 0·0909 grm. of sulphate of lead. To hold dissolved 1 part of sulphate of lead in the dilute alcohol charged with sulphate of ammonium, there was consequently required 110 c.c. of a tolerably strong solution of acetate of ammonium.

Still another experiment with sulphuric acid was made, by mixing 10 c.c. of an entirely new preparation of acetate of ammonium with a similar quantity of the standard solution of acetate of lead, and dropping the standard sulphuric acid into the mixture. No persistent precipitate was produced in this case until 5 c.c. of the acid had been added. This quantity of the standard acid contained 0·049 grm. of sulphuric acid, corresponding to 0·1515 grm. of sulphate of lead; hence only 33 parts of the solution of acetate of ammonium were required to dissolve 1 part of sulphate of lead. It is to be observed that the insolubility of tartrate, citrate, and succinate of lead in alcohol prevents the application of this modified form of the experiment in the examples given below. With the exception of the acetates of ammonium and sodium, none of the salts experimented with can be mixed with the acetate of lead and subsequently tested with sulphuric acid or sulphate of ammonium.

Acetate of Sodium, whether mixed with the normal sulphuric acid, with sulphate of ammonium, or with acetate of lead, seemed to have no solvent action upon sulphate of lead.

Neither *Oxalate of Ammonium* nor normal *Oxalate of Potassium* exerted any solvent action, either in presence of the sulphuric acid or the sulphate of ammonium.

Tartrate of Ammonium.—Normal, crystallised tartrate of ammonium was dissolved in alcohol of 18 per cent, in such proportions that 500 c.c. of the solution contained 1-10th of an equivalent, 18·4 grms. of the salt. Twenty-five c.c. of the solution were mixed with an equal volume of the normal sulphuric acid; and normal acetate of lead was added to the mixture until a permanent precipitate was produced. To effect this result, there was required of the standard solution of acetate of lead 2 c.c., or 0·0758 grm. of the acetate, corresponding to 0·0606 grm. of sulphate of lead. The 25 c.c. of the solution of tartrate of ammonium contained 0·92 grm. of the dry salt. Hence, something more than 15 parts of tartrate of ammonium are required to hold 1 part of sulphate of lead dissolved in diluted alcohol containing free sulphuric acid.

In two other experiments, where the tartrate of ammonium solution was mixed with the sulphate of ammonium, instead of with free sulphuric acid, 3 c.c. of the acetate of lead solution had to be added before a permanent precipitate could be formed.

That sulphuric acid is a more efficient precipitant o lead in presence of tartaric acid than sulphate of ammonium was shown in another way. Thirty c.c. of the standard alcoholic acetate of lead were mixed with an equal volume of the standard solution of tartrate of ammonium. The precipitated tartrate of lead was filtered, and the filtrate mixed with a quantity of the sulphate of ammonium solution. No precipitate was produced, though, on the subsequent addition of sulphuretted hydrogen, a slight precipitate of sulphide of lead was formed. In a similar experiment, where sulphuric acid was substituted for sulphate of ammonium, a slight precipitate was produced by the sulphuric acid, and no precipitate could be obtained afterwards with sulphuretted hydrogen.

In two other experiments, where 5 c.c. of the acetate of lead solution were mixed with 30 c.c. of the tartrate of ammonium, no precipitate was produced by sulphate of ammonium in the filtrate from the tartrate of lead, while sulphuric acid gave a slight precipitate as before. In this case, however, sulphuretted hydrogen gave a slight precipitate after sulphuric acid as well as after sulphate of ammonium.

Normal *Tartrate of Potassium*, mixed with the solution of sulphuric acid, exerted no solvent action on sulphate of lead.

Succinate of Ammonium, prepared by neutralising a solution of succinic acid with ammonia-water, exerted no solvent action when mixed with the free sulphuric acid; but, when mixed with the solution of sulphate of ammonium, 6 c.c. of the acetate of lead solution were added to the liquor before a permanent precipitate fell.

Normal *Citrate of Ammonium* was prepared by neu-

tralising a weighed equivalent portion of crystallised citric acid with ammonia-water. Ten c.c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the standard solution of acetate of lead was dropped into the mixture in the usual way. No permanent precipitate was formed until 16 c.c. of the lead solution had been added. These 16 c.c. contained 0·6064 grm. of acetate of lead, corresponding to 0·4848 grm. of sulphate of lead. The 10 c.c. of citrate of ammonium solution contained 0·42 grm. of crystallised citric acid. Hence, 1 part of sulphate of lead was held dissolved in the mixture of alcohol and dilute sulphuric acid for every 0·8663 part of citric acid in the liquor.

On repeating the experiment, a precisely similar result was obtained: 16 c.c. of the standard lead solution had to be added to the mixture of alcohol and sulphuric acid before the precipitate ceased to re-dissolve as fast as it formed.

In two other experiments, where, instead of free sulphuric acid, 10 c.c. of the standard solution of sulphate of ammonium were mixed with 10 c.c. of the citrate of ammonium solution, 30 c.c. of the standard lead solution had to be added in each case before any permanent precipitate formed.

Dicitrate of Ammonium $C_{12}H_6(NH_4)_2O_{14}$, was prepared in crystals, and 22·6 grms. of the salt were dissolved in 500 c.c. of the 18 per cent alcohol. Twenty-five c.c. of the solution were mixed with an equal volume of the standard sulphuric acid, and the acetate of lead solution was dropped into the mixture in the usual way. After the addition of 8 c.c. of the standard acetate of lead, a permanent precipitate was produced. These 8 c.c. contained 0·3032 grm. of acetate of lead, corresponding to 0·2424 grm. of sulphate of lead. The 25 c.c. of dicitrate of ammonium solution contained 1·13 grms of the dry salt. Hence, 1 part of sulphate lead was held dissolved for every 4·6617 parts of the dicitrate.

Tricitrate of Potassium.—Twenty-five c.c. of a standard solution of ordinary crystallised citrate of potassium, mixed with an equal volume of the standard sulphuric acid, gave no permanent precipitate until 2 c.c. of the solution of acetate of lead had been added to it.

Sugar.—A standard solution of cane-sugar, mixed with an equal volume of the sulphuric acid, gave a permanent precipitate on the addition of the first drop of the acetate of lead.

These experiments show clearly that very considerable quantities of sulphate of lead can be held in solution by weak alcohol charged with various salts. It may, therefore, reasonably be inferred that wines sometimes retain lead in solution, in consequence of this action of the acids and salts peculiar to wine upon lead compounds ignorantly employed to correct acidity.

NOTE ON THE

SUPPOSED POLARISATION OF THE CORONA.*

BY PROF. E. C. PICKERING.

An observation on this subject is given in my report in the Chemical News (vol. xx., p. 222; *Am. Repr.*, *Jan.* 1870, *page* 14), but as the form of the instrument used has been in one or two cases misunderstood, I enclose a sketch of it. A, B (Fig. 1) is a sheet-iron tube,

Fig. 1.

closed at A with a plate of quartz, and at B with a prism of Rochon. The latter has the property of giving two images of any object seen through it, separated by an angle of nearly 3°. Looking through the tube we therefore see two images of the quartz touching, but not overlapping. When the light is polarised, these images assume complementary tints, which vary with the plane of polarisation and the thickness of the quartz. On turning this instrument towards the sun during totality, the images presented the appearance shown in Fig. 2.

The hexagons represent in form and size the plate of quartz; the black circles the moon, here drawn a sixth of

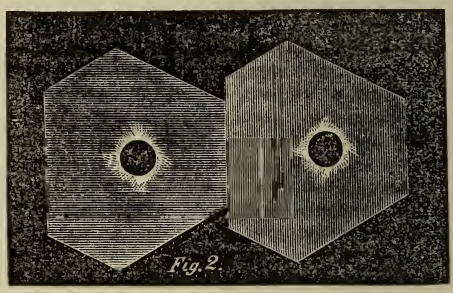


Fig. 2.

an inch in diameter, as the scale is about 3° to the inch The corona appeared white, but the sky surrounding it was coloured in one image blue, in the other yellow,—represented in the figure by vertical and horizontal lines. The conclusion to be drawn from this is, that the light of the corona is unpolarised, or, more strictly, that the amount of polarised light, if any, is too slight to be perceptible with this instrument. Its delicacy, although not equal to Savart's polariscope, is very great, giving coloured images with paper, wood, and other bodies which reflect a small amount of light specularly. The day before the eclipse it showed, in a very marked manner, the polarisation of the wet pavements and roofs. To measure its sensitiveness, I viewed the light reflected by a piece of plate glass, at different angles of incidence, and found that the colour ceased to be visible when this angle was about 10°, which, allowing for the reflection from the second face, would give about one part of polarised to twenty-four of natural light.

Observers heretofore have generally attached their polariscope to a telescope, and thus introduced a source of error, avoided in my instrument. For light passing through the object-glass and field lens would be polarised before reaching the polariscope by the obliquity of the incidence, caused both by the curvature of the surfaces and the fact that the edge of the field of view receives its light not parallel to the axis. The plane of polarisation would be perpendicular to a plane falling through the axis of the instrument. Now, if any part of the corona was brought into the centre of the field of view, the adjoining portions would appear polarised in planes parallel to the edge of the field, or passing through the sun's centre. In sweeping around the sun's edge, the plane of polarisation would continually

* Communicated by Prof. Morton, Editor of the *Journal of the Franklin Institute*, to whom we are indebted for copies of the wood-cuts.

change, as the corona passed through different parts of the field, and the comparative darkness of the moon's disk and the exterior sky prevent the polarisation of the other portions of the field from being visible. The degree of polarisation by refraction would be very slight and perhaps imperceptible, but the agreement of observation with this hypothesis is certainly a curious coincidence.

The strongest argument against the polarisation of the corona is furnished by the spectroscope, the presence of bright lines and absence of dark ones, as observed by Prof. Young, denoting incandescence, a view strengthened by the consideration that each square centimetre of the surface of the corona would receive several thousand units of heat per minute. I am well aware that my results are at variance with those obtained by previous observers, including some of the most eminent astronomers of the day, but as far as I can learn this form of polariscope has not been used for the purpose, and therefore hope that my experiment may be repeated during the next eclipse.

ON ESSENCE OF SASSAFRAS.

BY MM. E. GRIMAUX AND Y. RUOTHE.

Essence of *Laurus sassafras* is colourless when first rectified, but turns gradually yellow after exposure to air and light. Its smell resembles that of essence of fennel. Its density at zero is 1·0815; it rotates the polarised ray to the right, and its rotatory power is 3·5° for a length of 10 centimetres. It is a mixture of dextrogyrous hydrocarbon with an inactive oxygenated principle, and also contains small quantities of a body which is apparently a phenol, and which gives it the power of reducing nitrate of silver. This body is separated from the essence by stirring with this latter an aqueous solution of potash, which, after the addition of chlorhydric acid, precipitates some oily drops, having a strong smell of eugenic acid, and coloured light green by ferric chloride. By distilling this body with steam, a colourless liquid was obtained in just sufficient quantity to permit analysis, which gave C = 74·43, H = 6·46. Such extremely small proportions are found in the essence that it can scarcely be said to do more than exist. The hydrocarbide (safrène) contains $C_{10}H_{16}$, which formula is confirmed by the density of its vapour, which, ascertained by Dumas's method, was found equal to 4·71 (theoretically, 4·7). Safrène boils between 155° and 157°, is dextrogyrous, and its rotatory power is 17°·5 for a length of 10 c.c.; its density at zero is 0·8345.

Nine-tenths of the essence are extracted after the first distillation between 230° and 236°. They consist of an oxygenated principle (safrol), which distils chiefly between 231° and 233°. This latter has not a constant boiling point, for it always changes and becomes slightly resinous under the influence of much heat. It is insoluble in water, but difficult to dry over chloride of calcium, and requires rectification in a current of pure hydrogen before analysis. Its odour is similar to that of the essence; its density 1·1141 at zero; it exerts no influence on polarised light, and remains liquid at a cold as low as −20°. Safrol will not combine with bisulphites, dissolve sodium, or decompose chloride of benzoyle at its boiling point. It will not dissolve alcoholic potash even at 180°, but is changed by it into a black, non-crystallisable resin.

Treated with boiling iodhydric acid at 127°, it yields a thick green iodised oil; with perchloride of phosphorus it gives only a protochloride, and no trace of oxychloride, and the thick viscous body left in the retort after distilling the protochloride should be a monochlorurcted safrol. It does, in fact, present the appearance and qualities of those monobromised derivatives obtained by merely adding a molecule of bromine to a molecule of safrol, but if excess of bromine be added, a solid crystallised derivative of pentabromised safrol, $C_{10}H_5Br_5O_2$, is obtained. To prepare this body, dissolve safrol in sulphide of carbon, and add five times its weight of bromide; after a few days the vessel will be found to contain crystals. Dissolve these in chloroform, wash the solution with potash, and concentrate; rectangular and perfectly white flakes of pentabromised safrol, $C_{10}H_5Br_5O_2$, will separate.

This body melts at 169° or 170°, is but slightly soluble in alcohol or ether, even at the boiling point, and dissolves in about fifteen times its weight of chloroform, with simultaneous production of a very small quantity of another bromised derivative melting at 109°. Upon subjecting safrol to the action of sundry other reagents, no satisfactory results were obtained. Nitric acid, even when much diluted, renders it resinous, with production of oxalic acid; it dissolves in the fuming acid, yielding a non-crystallisable derivative, soluble in alkalies at moderare temperature. When heated with chloride of zinc or phosphoric anhydride, it quickly decomposes, leaving much carbon; sulphuric acid produces the same effect. Fusing potash attacks it with difficulty; a distillation of the essence over melting potash modifies its boiling point; that which formerly distilled between 230° or 234°, now comes over between 245° and 250°, and even at from 247° to 248°. The analysis of this body gives the same figures as that of the essence.

ON THE

METHODS OF ANALYSIS

AND THE

COMPOSITION OF VARIOUS CHEMICAL MANUFACTURING PRODUCTS.

BY M. GASTON TISSANDIER.

(Continued from Am. Repr., Jan. 1870, page 4.)

Animal Black.

The consumption of animal black in sugar factories is very considerable; and this product now plays a prominent part in commerce. After having been used in the clarifying of sugar, animal black is sometimes employed in agriculture; but on this point we shall examine it more particularly in speaking of manures.

Ash.—The sample to be analysed is ground and sifted; 2 grms. are taken and calcined in a platinum crucible till the perfectly white residue contains no further traces of carbon. This residue, when weighed, gives the proportion of ash contained in 2 grms. of material. The carbon and moisture are given by difference. Care must be taken to moderate the heat in this calcination, so as not to decompose the carbonate of lime contained in the ash.

Carbon.—5 grms. of animal black are dried at 110° in a stove, or in a paraffin-bath; the loss of weight gives the moisture, which, subtracted from the loss by calcination, furnishes the proportion of carbon.

Silica.—The ash obtained by the calcination of animal black is dissolved in water acidulated with chlor

hydric acid; it is slightly heated, and the insoluble siliceous remainder is filtered and weighed.

Phosphate of Lime.—To the filtered solution is added a slight excess of ammonia, which precipitates all the phosphate of lime ($PO_5,3CaO$); it is filtered, and the precipitate is dried, calcined, and weighed.

Carbonate of Lime.—The liquid, separated by filtration from the phosphate of lime, contains carbonate of lime, which is precipitated at the boiling point by oxalate of ammonia. The precipitate of oxalate of lime is collected; this it is well to filter and wash by decantation, pouring the washing-water on the filter. The calcination of this precipitate necessitates, as is well-known, some precautions. The oxalate of lime must be heated to a sufficient temperature (approaching red-heat), to transform it into carbonate of lime; but the heat must not be so great as to decompose the residue of carbonate of lime. After having weighed the carbonate of lime, the operation may be controlled in the following manner:—The precipitate is moistened with sulphuric acid; it is calcined, in order to get rid of the excess of this acid, and the sulphate of lime obtained is weighed. This amount ought to correspond with the quantity of carbonate of lime, if the operation has been properly executed. Animal black contains traces of magnesia, which can be estimated in the form of ammonico-magnesian phosphate.

Soluble Salts.—50 grms. of animal black are weighed and thrown into a little stoppered flask containing about 50 c.c. of distilled water; this is well shaken for a few minutes, and then filtered. The insoluble residue is redigested in a fresh quantity of water; and this is repeated several times, so as to eliminate the whole of the soluble salts. The filtered liquid is evaporated over the sand-bath in a little porcelain capsule; the dry residue is weighed, and its weight gives the proportion of soluble salts. These salts consist of alkaline chlorides, sulphates, and carbonates; they also contain traces of sulphate of lime and sulphide of calcium.

Composition of Animal Black used in Sugar Refining.

Substances Estimated.	I.	II.	III.	
Water	2·00	1·37	1·21	Loss on calcination.
Carbon	8·42	9·90	11·12	
Carbonate of lime	14·92	13·80	12·22	Ash.
Phosphate of lime	72·50	72·25	74·43	
Silica	1·80	2·50	0·40	
Soluble salts	0·36	0·18	0·62	
Total	100·00	100·00	100·00	

Decolourising Power.—We have devised a method which enables us to compare the decolourising power of an animal black with that of another black of good quality, taken as a standard, and to represent the relation of the two decolourising powers by an exact number.

10 grms. of the standard black, and 10 of the black under assay, are weighed; the two samples, finely pounded, are placed separately on two filters of the same size.

A solution of caramel in water is prepared, so as to produce a rather dark colour, somewhat like that of weak tea. The first standard black is moistened with 20 c.c. of this solution, which runs through colourless; 20 more c.c. are passed through, and so on till the liquor passes coloured. When it presents just the same shade as the unfiltered solution of caramel, the operation is stopped.

The same experiment is made with the black under assay, placed on the second filter, and the quantity of solution required to be passed through until it is of the same colour noticed, as in the preceding experiment. Let us suppose that the standard black decolourised eight pipettes full of the caramel solution, and the black under assay only four: we say that the decolourising power of the latter is equal to one-half, relative to that of the former.

A solution of caramel may be kept ready prepared, so as to serve as a testing liquid.

Acetic Acid.

Acetic acid, sometimes called, in commerce, pyroligneous acid, generally contains about 40 per cent. of acetic acid, $C_4H_4O_4$; it is sold by the acidimetric standard, which is determined by means of a titrated alkaline liquid.

Acidimetric Standard.—Preparation of the Alkaline Liquid.—We have already shown how the alkalimetric sulphuric acid may be prepared accurately; this well-verified solution, containing 100 grms. of sulphuric acid per litre, is the basis of the preparation of the alkalimetric liquid which, in laboratories, is used to effect nitrogen determinations or to take acidimetric standards.

Any quantity whatever of pure caustic soda—15 or 18 grms., for instance—is dissolved in a litre of water. 10 centimetres of the normal sulphuric acid liquor (containing 1 grm. of SO_3HO) are taken and poured into a small precipitating glass; to this is added some sensitive tincture of litmus, and the solution of caustic soda poured into it drop by drop by means of a graduated burette, divided into tenths of c.c., till the red litmus becomes blue—that is to say, till the acid is saturated. Let us suppose that 50 c.c., or 500 divisions, of our alkaline solutions are required to saturate 10 c.c. of the titrated sulphuric acid liquid. We know that 500 divisions saturate 1 grm. of sulphuric acid, and we can calculate, according to the equivalents, what quantity of acetic acid will saturate a certain volume of our liquid; we know, for example, that 500 divisions ought to saturate 1·224 grms. of acetic acid, $C_4H_4O_4$:—in fact,

$$\frac{49(SO_3,HO)}{60(C_4H_4O_4)} = \frac{1.}{x}$$

Before thus standardising the alkaline liquor of caustic soda, it is well to add some slaked lime, to prevent it from carbonating, which would interfere with the sharpness of the colouration of the red litmus into blue. Before using this liquor, the bottle which contains it is shaken, and left to settle, so that the lime may be deposited at the bottom; the solution, becoming clear in a few minutes, is then poured into the graduated burette, which is used to take the standard of pyroligneous acid under assay.

According to arrangement between the buyer and seller, the standard of this acid is taken either by *volume* or by *weight*. In the former case, 1 c.c. of acetic acid is saturated, in the latter 1 grm.

In order to take the standard by weight, a small glass, containing in it a 10-grm. weight, is tared on a sensitive balance. Equilibrium being established, the 10-grm. weight is taken out, and the acetic acid to be tested is then gradually poured into the glass by means of a small tube, so as to regain the equilibrium. We have thus, by double weighing, obtained 10 grms. of acetic acid, which are to be diluted with water so as to give a volume of 100 c.c.

After this solution has been rendered homogeneous by shaking, 10 centimetres of it are removed, corresponding to 1 grm. of acetic acid. Instead of directly weighing 1 grm. of the acid to be tested, it is better to weigh 10 grms. of it, as we have indicated; because, in case of a verification being needed, it is easier to measure 10 c.c. than to commence a fresh weighing.

The 10 centimetres deducted are placed in a precipitating jar, litmus is added, and the alkaline soda liquid poured in, drop by drop, till the litmus becomes clearly blue. If 150 divisions have been used, we shall obtain the acidimetric standard of pyroligneous acid by the following equation:—

500 divisions saturate..... 1·224 grs. of $C_4H_4O_4$
150 " will saturate.... x.

whence—

$$x = 0{\cdot}3672.$$

100 grms. of the assayed acetic acid contain, then, 36·72 grms. of $C_4H_4O_4$, which is expressed by saying that its standard is 36·72°.

When the standard is taken by volume, the operation is the same; only, instead of weighing 10 grms. of the acid. 10 c.c. are measured.

Examination for Mineral Acids.—Acetic acids are sometimes adulterated with mineral acids (chlorhydric and sulphuric, &c.), which augment their standard.

To detect their presence, 50 c.c. of acetic acid are heated to the boiling point with 1 or 2 centigrms. of starch, and left to boil about twenty minutes. When the liquid has become cold, some drops of tincture of iodine are poured into it. If a blue colouration of iodide of starch occurs, the acetic acid contains no mineral acids; but if this colouration is not produced, we may be certain of the presence of mineral acids, which, under the action of heat, have transformed the starch into dextrine, and thus prevented the formation of the iodide. Care must be taken to pour the iodine into the cold liquid, for iodide of starch is decolourized spontaneously under the action of heat. Chlorhydric acid may also be immediately detected, by adding to the acetic acid a few drops of nitrate of silver; and the presence of sulphuric acid is discovered by chloride of barium. In the latter case, it must not be forgotten that choride of barium is insoluble in acids, and that the acetic acid ought to be diluted with a sufficiently large quantity of water to avoid the possibility of error from this cause.

Pyroligneous acids generally standardise 39° to 40°; however, this figure is not absolute. We have sometimes met with samples containing only 34 per cent of acetic acid, others having 46 to 50 per cent, and even still larger quantities.

(To be continued).

ON THE

METHOD OF ANALYSING SILICATES THAT DO NOT GELATINISE WITH HYDROGEN CHLORIDE.*

BY NEVIL STORY-MASKELYNE, M.A.,

PROFESSOR OF MINERALOGY IN THE UNIVERSITY OF OXFORD, AND KEEPER OF THE MINERAL DEPARTMENT, BRITISH MUSEUM.

The process is conducted in an apparatus of the following constructions:—A platinum retort, 30 c.c. in capacity, is fitted with a tubulated stopper of the same material, which reaches nearly to the bottom; a small tube, entering the vertical tube of the stopper at an angle above the neck of the retort, conveys hydrogen to its interior. The vertical tube can be closed, either by a stopper of platinum, or by a funnel of that metal, stopped in like manner at the top, and having a fine orifice at its lower extremity.

To the side of the retort, just below its neck, a straight delivery tube is fixed, which in its turn fits into another platinum tube that, after taking a curve into a vertical position, is enlarged into a cylinder, which passes a considerable distance down a test-tube. The latter, into which the delivery tube is fitted with a cork, holds 7·5 c.c., or 6·6 grms. of strong ammonia of the sp. gr. 0·88.

The gas delivery tube inserted in the side of this receiver dips into some more ammonia in a second test-tube.

The pounded mineral, from 0·2 to 0·5 grm. in quantity, and a small platinum ball, are placed in the retort, and the stopper luted to it with gutta-percha, and cemented air-tight in its place with caoutchouc and gutta-percha varnish. The funnel, filled with perfectly pure hydrogen fluoride, is now introduced into the tubulure of the stopper, the tap opened, and the acid allowed to run down into the retort. This acid contains about 32 per cent of absolute hydrogen fluoride —that is to say, a funnel of this reagent contains 1·12 grms. of acid, capable of rendering gaseous 0·84 grm. of silica, and of neutralising 0·95 grm. of ammonia. The funnel is now replaced by a little platinum stopper, and the orifice secured air-tight with gutta-percha varnish. Pure hydrogen is then allowed slowly to traverse the entire apparatus; the retort is placed in a water-bath at 100° C. for two hours, and occasionally slightly shaken to set the ball rotating. During the operation, a trace only of silicium difluoride passes over.

The retort is next transferred to a paraffin bath, and the temperature is cautiously raised. At first, hydrogen fluoride passes over, and at this point of the process the flow of hydrogen requires some attention to prevent regurgitation of the ammonia. At about 132° C., in the case of the silicates mentioned in this memoir, the silica first becomes visible in fine flocks in the ammonia of the receiver, and in another minute the whole is cloudy.

In eight minutes, the rise of the thermometer to 145° C. has brought over so much difluoride that the contents of the tube are semi-solid, and nearly the whole of it has passed over. The temperature is then raised to 150° C., and the retort allowed to cool. The process is next repeated with a fresh charge of acid and ammonia. If no more than 0·2 grm. of silicate be taken, twice charging of the retort is sufficient; but with 0·5 grm. three or four repetitions of the process are required. In short, the operation is continued with fresh reagents till no flock of silica forms in the receiver. Finally, 0·75 c.c. of sulphuric acid is introduced into the retort, and the temperature again raised to 160° C., the stream of hydrogen being continued as before.

The several ammoniacal charges are poured into a platinum dish, together with the washings of the delivery tube, and the two test-tubes, and slowly evaporated in a water-bath with continued stirring.

At a point in the evaporation just before the solution becomes neutral, and the ammonium fluoride begins to turn acid, the entire silica in the dish will have been

* Extracted from a paper "On the Mineral Constituents of Meteorites," communicated to the Royal Society.

dissolved by the fluoride. The process is gradual, but the moment when the solution is complete is easily determined. Then, the dish being removed, potassic chloride is added in slight excess, together with absolute alchohol equal in volume to the contents of the platinum vessel. Potassium fluosilicate precipitates, which, after the lapse of twenty-four hours, is filtered, weighed with a mixture of equal volumes of absolute alcohol and water, dried, and washed. The results are accurate. In the retort are the bases in the form of sulphates, the treatment of which calls for no further remark.

ON FLUORIDE OF SILVER.*

BY GEORGE GORE, F.R.S.

This communication treats of the formation, preparation, analysis, composition, common physical properties, and chemical behaviour of fluoride of silver.

The salt was prepared by treating pure silver carbonate with an excess of pure aqueous hydrofluoric acid, in a platinum dish, and evaporating to dryness, with certain precautions. The salt thus obtained invariably contains a small amount of free metallic silver, and generally, also, traces of water and of hydrofluoric acid, unless special precautions mentioned are observed. It was analysed by various methods. The best method of determining the amount of fluorine in it consisted in evaporating to dryness a mixture of a known weight of the salt, dissolved in water with a slight excess of pure and perfectly caustic lime in a platinum bottle, and gently igniting the residue at an incipient red heat until it ceased to lose weight. By taking proper care, the results obtained are accurate. The reaction in this method of analysis takes place according to the following equation:—

$$2AgF+CaO=CaF_2+2Ag+O.$$

Sixteen parts of oxygen expelled equal 38 parts of fluorine present. One of the methods employed for determining the amount of silver consisted in passing dry ammonia over the salt in a platinum boat and tube at a low red heat. The results attained in the various analyses establish the fact that pure fluoride of silver consists of 19 parts of fluorine and 108 of silver.

Argentic fluoride is usually in the form of yellowish brown, earthy fragments; but, when rendered perfectly anhydrous by fusion, it is a black, horny mass, with a superficial satin lustre, due to particles of free silver. It is extremely deliquescent and soluble in water. One part of the salt dissolves in 0·55 part by weight of water at 15·5° C.; it evolves heat in dissolving, and forms a strongly alkaline solution. It is nearly insoluble in absolute alcohol. The specific gravity of the earthy brown salt is 5·852 at 15·5° C. The specific gravity of its aqueous solution, 15·5° C., saturated at that temperature, is 2·61. By chilling the saturated solution, it exhibited the phenomenon of supersaturation, and suddenly solidified, with evolution of heat, on immersing a platinum plate in it. The solution is capable of being crystallised, and yields crystals of a hydrated salt. The act of crystallisation is attended by the singular phenomenon of the remainder of the salt separating in the anhydrous and apparently non-crystalline state, the hydrated salt taking to itself the whole of the water. The fused salt, after slow and undisturbed cooling, exhibits crystalline markings upon its surface.

* Abstract of a paper read before the Royal Society.

The dry salt is not decomposed by sunlight. It melts below a visible red heat, and forms a highly lustrous, mobile, and jet-black liquid. It is not decomposed by a red heat alone; but, in a state of semi-fusion, or of complete fusion, it is rapidly decomposed by the moisture of the air, with separation of metallic silver. Dry air does not decompose it. In the fused state, it slightly corrodes vessels of platinum, and much more freely those of silver.

The salt, in a state of fusion, with platinum electrodes, conducts electricity very freely, apparently with the facility of a metal, and without visible evolution of gas or corrosion of the anode. A silver anode was rapidly dissolved by it, and one of lignum-vitæ charcoal was gradually corroded. A saturated aqueous solution of the salt conducted freely with electrolysis, crystals of silver being deposited upon the cathode, and a black crust of peroxide of silver upon the anode; no gas was evolved. With *dilute* solutions, gas was evolved from the anode. By electrolysis of anhydrous hydrofluoric acid with silver electrodes, the anode was rapidly corroded.

The electrical order of substances in the fused salt was as follows, the first-named being the most positive:—Silver, platinum, charcoal of lignum-vitæ, palladium, gold. In a dilute aqueous solution of the salt, the order found was:—Aluminium, magnesium, silicon, iridium, rhodium, and carbon of lignum-vitæ, platinum, silver, palladium, tellurium, gold.

The chemical behaviour of the salt was also investigated. In many cases, considerable destruction of the platinum vessels occurred, either in the experiments themselves, or in the processes of cleaning the vessels from the products of the reactions.

Hydrogen does not decompose the dry salt, even with the aid of sunlight; nor does a stream of that gas decompose an aqueous solution of the salt; but the dry salt is rapidly and perfectly decomposed by that gas at an incipient red heat, its metal being liberated.

Nitrogen has no chemical effect upon the salt, even at a red heat, nor upon its aqueous solution. Dry ammonia gas is copiously absorbed by the dry salt. In one experiment, the salt absorbed about 844 times its volume of the gas. The salt, in a fused state, is rapidly and perfectly decomposed by dry ammonia gas, and its silver set free. A saturated solution of the salt is also instantly and violently decomposed by strong aqueous ammonia.

Oxygen has no effect neither upon the dry salt at 15° C., or at a red heat, nor upon its aqueous solution. Steam perfectly and rapidly decomposes the salt at an incipient red heat, setting free all its silver. No chemical change took place on passing either of the oxides of nitrogen over the salt in a state of fusion.

By passing anhydrous hydrofluoric acid vapour over perfectly anhydrous and previously-fused fluoride of silver, at about 60° F., distinct evidence of the existence of an acid salt was obtained. This acid salt is decomposed by a slight elevation of temperature.

Numerous experiments were made to ascertain the behaviour of argentic fluoride, in a state of fusion, with chlorine; and great difficulties were encountered, in consequence of the extremely corrosive action of the substances when brought together in a heated state. Vessels of glass, platinum, gold, charcoal, gas carbon, and purified graphite were employed.* By heating the salt in chlorine, contained in closed vessels formed

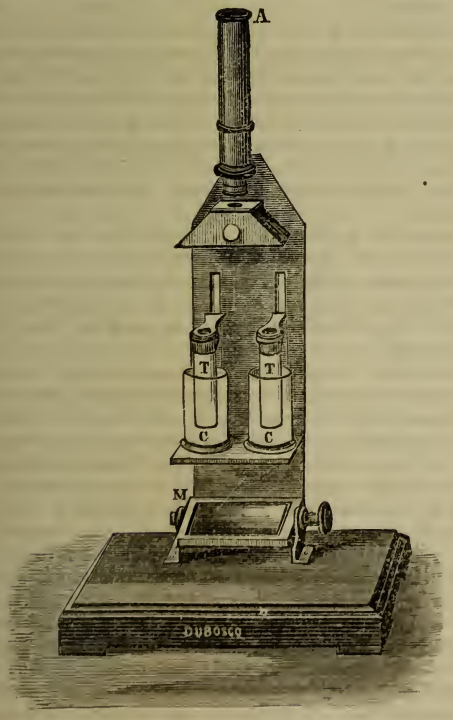
* In the next communication there will be described the results obtained with vessels formed of other materials.

partly of glass and partly of platinum, more or less corrosion of the glass took place, the chlorine united with the platinum and fluoride of silver to form a double salt, and a vacuum was produced. By similarly heating it in vessels composed wholly of platinum, the same disappearance of chlorine, the same double salt, and a similar vacuum resulted. Also, by heating it in vessels composed partly of gold, an analogous double salt, the same absorption of chlorine, and production of rarefaction was produced. And, by employing vessels partly composed of purified graphite, a new compound of fluorine and carbon was obtained.

DUBOSCQ'S NEW COLORIMETER.*

M. Duboscq has submitted to the Academy of Sciences his new colorimeter for measuring the differences of tint in solutions. The two liquids are placed in the two cylindrical vessels, c, c', of glass, fixed side by side, before the vertical shelf of the colorimeter.

In the two vessels, two tubes of smaller diameter, t, t', closed at the lower extremity by a disc of glass, may be raised and lowered by means of the movable pinions engaged by two racks cut into the vertical table. To each pinion is fastened a vernier, which is moved under a graduated scale, and which measures the distance between the bottom of the vessels and the lower disc of the movable tube.

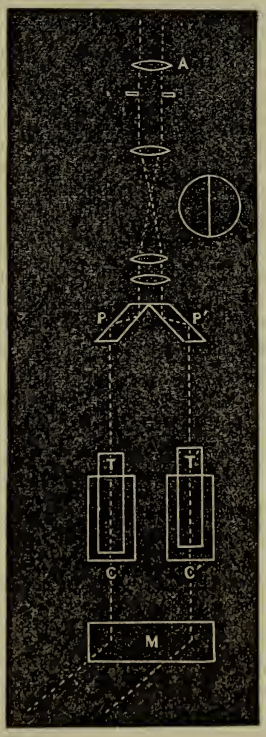


The luminous rays transmitted by the two columns properly illuminated by a mirror, M, placed above, and moved around in a horizontal axis, suffer each two reflections, within one of Fresnel's rhombs, P, P', and then arrive in the same field of vision, in such a manner that each shall illuminate the half of the field with a semi-disc or circle of yellow colour, more or less intense. These colours are observed with a small lens, which is nothing but the base of a terrestrial eye-piece, formed of four glasses, and which magnifies sufficiently, so that the field may be illuminated by the coloured plates with perfect uniformity.

The colours are proportional to the height of the columns if the liquid contain the same proportion of caramel; or proportional to the richness of the liquid in caramel, if the two columns have the same height.

In the last case, if we cause the height to vary, we have the same shade on these to semi-discs.

Suppose that the standard solution is in the cup to the right, and that we lower the interior disc or movable tube to 20 millimetres from the bottom of the cup; we will thus have a column of 20 millimetres, which gives to the half disc of the left-hand side a pale yellow colouration. Admitting, then, that the half disc at the right has the same colouration, but that the column of the liquid placed in the cup to the left has not a height of 40 millimetres, this informs us that the solution to be tried contains a proportion of caramel more than that contained in the standard liquid.



In fact, for the same colour on the two semi-discs, the proportions of caramel contained in the two liquids are inversely as the height which we give to the column of the liquids.

One hundred centimetres of the solution tried, contained, then, in the case we speak of,

$$\frac{0 \text{ gr. } 2}{2}$$

of caramel.

If we have dissolved, for example, 10 grammes of syrup in 100 c.c. of water, we should know that 10 grammes of the syrup contained one d. c. g. of caramel.

* For this description as well as for the illustrative cuts we are indebted to the courtesy of Professor Morton.

NEW METHOD FOR THE SEPARATION OF THE PLATINUM METALS.*

BY PROFESSOR BUNSEN.

In the metallurgic process of extracting platinum from its ores, there are obtained three products, which are admirably adapted for obtaining those rare metals which constantly accompany this metal. These products are:—

1. The "Ore residues," which remain behind after the mass of platinum, &c., has been extracted by aqua regia; these are rich in osmium and iridium, hence best adapted to the purpose of extracting these metals.

* Translated from his late contribution to the *Annalen der Chemie und Pharmacie*, entitled "Ueber das Rhodium," by W. H. Wahl. Communicated by Professor Morton, editor of the *Journal of the Franklin Institute*.

2. "Osmiridium," obtained, by mechanical washing, from the first residue, and which is best adapted for obtaining ruthenium.

3. The "Mother-Liquid Residues," left behind in the aqua regia solutions after reduction with iron, the platinum having previously been separated (with chloride of potassium?). These are rich in palladium and rhodium, and are the best for obtaining these metals.

The following researches were made with a material of the last sort; for each separation, 1 kilo. of residue was used.

The residue contains, with the exception of osmium, all the platinum metals, and is particularly interesting on account of its relatively great richness in rhodium.

Claus's mode of separation (the only one previous to this) involves the loss of much valuable material. To separate the rhodium from iridium, Claus used the old method proposed by Wollaston, which depends upon the solubility of the ammonium (or potassium) double salt of sesquichloride of rhodium in chloride of ammonium. The fact, however, that the salt $KCl,IrCl_2$, is taken up in considerable quantity by a solution of chloride of ammonium (or chloride of potassium) saturated with a rhodium double salt, a fact of which I have repeatedly convinced myself, is sufficient to awake the gravest doubts as to whether the metal given out to be rhodium, and to which Berzelius and Claus ascribe the atomic weight = 52, did not contain considerable quantities of iridium. I found it, therefore, necessary to leave the beaten track, and to search for a more exact method of separation.

[Separation of Platinum and Palladium from the other Metals of the Group.

The complete separation of rhodium, iridium, and ruthenium from platinum and palladium, by digestion with aqua regia, will not succeed with these questionable residues, as considerable quantities of the first-named metals are present in the form of hydrated sesquioxides, and partly present in a most finely-divided state, and in consequence, dissolve with the platinum and palladium; without taking into consideration the fact that the residue left behind by this digestion is only filtered with infinite difficulty.

On the other hand, it is easy to effect the separation of platinum and palladium from the others, almost completely, if the original material is mixed in a Hessian crucible with from $\frac{1}{2}$ to $\frac{1}{3}$ its weight of chloride of ammonium, heated until the latter is completely volatilised, allowed to glow gently until only the vapours of sesquichloride of iron show themselves, and then placed in a porcelain dish and evaporated to a syrupy consistency with from two to three times its weight of raw *commercial* nitric acid. By this treatment with chloride of ammonium, the metals present not belonging to the platinum group will have been partially converted to *lower chlorides;* rhodium, iridium, and ruthenium will have been rendered insoluble, and the silica, present as gangue, converted from a gelatinous mass to a finely-pulverulent condition, in which state it will admit of speedy filtering.

The chlorine compounds, produced by the chloride of ammonium, give us, upon digestion with nitric acid, just enough hydrochloric acid to dissolve the platinum to bichloride, while the metallic copper and iron present act in so far reducing upon the palladium (in solution in nitric acid) that it remains in solution, not as bichloride ($PdCl_2$), but as the protochloride (PdCl), which latter is not precipitated with chloride of potassium. The mass is diluted with water, filtered, and the solution saturated with chloride of potassium, and the greater part of the platinum separated pure as $KCl,PtCl_2$, which is washed out, first with chloride of potassium, and later with absolute alcohol (the last washings must not be added to the solution). This precipitate weighed 62 grms.

The filtrate is brought into a large flask (which can be made air-tight) which will not be more than half-filled with it. Chlorine gas is led into this flask, and the same is, from time to time, shaken vigorously until no further absorption of gas takes place, when all the palladium will have separated as a cinnabar-red precipitate of $KCl,PdCl_2$ (somewhat impure, however, from traces of platinum, iridium, and rhodium). This precipitate weighed 157 grms. The fluid from which these precipitates were obtained is now evaporated, not quite to dryness, with hydrochloric acid; and, upon addition of *just so much water as was necessary* to dissolve out the chloride of potassium and other soluble salts (aiding the operation by rubbing with a pestle), there remained behind a dirty, yellow-coloured precipitate. This was separated by filtration, boiled with caustic soda and a few drops of absolute alchohol. Hydrochloric acid was added to dissolve the precipitate formed, and the liquid then saturated with chloride of potassium. Result was a precipitate of 13·5 grms. of chemically pure $KCl,PtCl_2$. The mother liquid contained only copper, and no platinum metals.

The purification of the cinnabar-red precipitate of palladium was accomplished as follows:—It was dissolved in boiling water, whereby a portion of the chloride dissolves, with evolution of chlorine, to PdCl. It was then evaporated with 60 grms. of oxalic acid, and dissolved again in a solution of chloride of potassium; whereupon 42 grms. of $KCl,PtCl_2$ remained behind, which, upon testing, proved chemically pure. It was washed out as before.

The brown liquid was then somewhat concentrated upon the water-bath; and, upon cooling, there separated 19 grms. of bright green, well-formed crystals of KCl,PdCl (with some chloride of potassium), which, upon testing, likewise proved free from the other platinum metals.

The fluid poured off from these crystals was then neutralised carefully with caustic soda, and gave a very slight precipitate of copper and iron, which was filtered off. Upon adding iodide of potassium to the filtrate, all the palladium separated as PdI. To avoid adding an excess of the reagent, it is best to take, from time to time, a drop from the fluid with a capillary tube, and bring the same upon a watch-glass. As long as the precipitation is incomplete, the drop appears, upon a white background, *brown;* when complete, it is *colourless;* when the reagent is present in excess, it is *red.* This weighed 77 grms, and was tested for its purity by reducing it to metallic palladium, and then heating and dissolving in nitric acid; when pure, it must dissolve completely. The whole mass was now reduced in a slow stream of hydrogen gas (whereby the iodine can be obtained again, as hydriodic acid, by absorbing with water). At last, the mass must be strongly heated, to decompose slight traces of the subiodide of palladium (Pd_2I) which are formed.

The mother liquid from which all this platinum and palladium has been obtained may contain some iridium and rhodium; it is, therefore, evaporated to dryness with a little iodide of potassium, whereby a mixture of

the iodides of rhodium and iridium separates. This can either be dissolved in aqua regia and the two metals separated (as will hereafter be described) by the bisulphite of soda, or it can be united with the portions from which these metals will be obtained.

Separation of Ruthenium, and of Rhodium and Iridium.

The residue from 1 kilo. of the original material which remained, after treatment with chloride of ammonium and nitric acid, weighed 400 grms. It was treated as follows, to get the metals in a form adapted to further chemical treatment.

The method depends upon the behaviour of chloride of zinc to zinc. If a piece of zinc be smelted, it rapidly covers itself with a stratum of oxide. If, to the smelted metal, a metal like iridium be added, the oxide stratum hinders the latter from coming into contact with the zinc, even though it be pushed beneath the surface. If, however, a few grains of chloride of ammonium be given to it, ammonia, hydrogen, and chloride of zinc will be formed, which last dissolves the oxide stratum to basic chloride of zinc. The zinc below resembles mercury in lustre and movability. As soon as the chloride has dissolved as much of the oxide as is possible for it, the oxide stratum again forms, and is instantly removed again by the addition of more chloride of ammonium. The melted zinc, strewn with chloride of ammonium, also possesses, like mercury, the property of attacking other metals, if the affinity exists of forming with them alloys. By strewing chloride of ammonium upon the melted zinc, a quiet surging is kept up as the ammonia and hydrogen are given off. Many oxides and chlorides (among which are those of the platinum metals) are, when they come into contact with this atmosphere of reducing gases, and with the basic chloride of zinc, instantly reduced and dissolved to alloys by the zinc. [We have here a means of separating quantitatively all metals which are not dissolved by zinc from those which are.] In making the solution, the zinc, in a porcelain dish, should be constantly rotated: the gangue remains in the basic chloride. The regulus, immediately upon solidifying, should be taken from the capsule, out of the yet-fluid basic chloride, and washed off with acetic acid until all the basic chloride is dissolved away. The gangue can be quantitatively determined by filtration and weighing. If the regulus is not immediately removed, the containing vessel will be broken, owing to the unequal expansion of the porcelain and the metal.

The best proportions for a quantitative separation are, to 1 part of the expected platinum metals, from 20 to 30 parts of zinc. For an ordinary separation, 7 parts of zinc are sufficient.

For the extraction of the residues remaining after our treatment with nitric acid, this method is admirably adapted. By fusing only once with zinc for two or three hours, all the platinum metals are extracted. The operation is the following:—

From 3 to 3·5 kilos. of commercial zinc were fused in a 2-litre Hessian crucible, chloride of ammonium, from time to time, strewn upon it, the 400 grms. of residue, previously heated to faint glowing with chloride of ammonium were added, and the temperature kept, for two or three hours, just above the fusing point of the alloy, by adding, whenever the mass threatened to solidify, some chloride of ammonium. The mass is divided into three strata after solidification has taken place.

The *outer* stratum, easily broken away by a blow from a hammer, contains *no* platinum metals. The *next* contains some particles of the zinc and platinum alloy, imbedded in the basic chloride of zinc; it is porous, and not very thick.

The *inner* stratum consists of a frequently beautiful crystalline regulus. To obtain the alloy from the middle stratum, it is only necessary to wash repeatedly with water; and the alloy gained is, of course, to be added to the regulus. To obtain this regulus as pure as possible, it was again fused with 500 grms. of zinc and some chloride of ammonium, then granulated in water, and the granules dissolved in fuming hydrochloric acid. The acid attacks the regulus with the greatest energy, and the solution was completed in less than an hour. The chloride of zinc can be used for the next operation.

The platinum metals are found at the bottom of the vessel, in the form of a finely-divided black powder, which is impurified with zinc, and with traces of iron, copper, &c., from the latter. It cannot be purified with nitric acid, nor with aqua regia, for part of the platinum metals will thereby be dissolved, or, at best, so suspended in the fluid that filtration is impossible. If, however, the powder is treated with hydrochloric acid, singularly enough, all the impurities are dissolved; not only zinc and iron, *but also lead and copper, dissolve readily, with the generation of hydrogen.* The explanation is readily found in electrical currents produced by the contact of the metals, the stream passing from the positive zinc, iron, &c., to the negative platinum metals, hydrogen being given on the latter, and chlorine on the former, and uniting with them. The metals (rhodium, iridium, &c.), after thorough washing, weighed 65 grms. This powder possesses the property, upon being gently heated, of exploding weakly, and, when highly heated, with violence, the explosion being accompanied with the evolution of light; thereby neither hydrogen, nor chlorine, nor nitrogen, nor aqueous vapour, are given off; and, as these are the only elements which it is possible that the metallic powder could have taken up, it must be assumed these metals are, by our treatment, converted into an allotropic condition, and that, upon heating, they return, with more or less energy, to their original condition. The powder contains, mainly, rhodium and iridium; but there are traces present of platinum, palladium, lead, copper, iron, and zinc.

It was intimately mixed with about three or four times its weight of completely anhydrous chloride of barium, and a stream of chlorine gas led over it at a tolerably high temperature. The operation is concluded when particles of sesquichloride of iron show themselves on the neck of the flasks containing the powder. It is carefully brushed away with filter paper. Some water was now added, and the mass of the platinum metals dissolved with the evolution of heat. There remained behind 13·7 grms. of insoluble matter, which, upon reduction with hydrogen, alloying with zinc, and treatment with hydrochloric acid, furnished 4·5 grms. of ruthenium. From the original 65 grms. of metal-powder, there were dissolved, in three hours, and with the use of four ordinary burners, 57 grms. of the platinum metals; there being consumed thereby 415 grms. of 85 per cent black oxide of manganese. From this solution all the chloride of barium was removed by careful addition of sulphuric acid [see the precipitation of palladium]. The platinum metals were now completely freed from all other metals, by reduction with hydrogen [with 100 grms. of material, this operation will require five or six days], the temperature being, throughout the operation, maintained at nearly 100° C., by means of the constant

water-bath. Platinum and palladium chiefly separate first; then mainly rhodium; and the last portions consist almost entirely of iridium. It is best to break off the operation when the fluid has assumed a greenish-yellow colour. The last portions of iridium (obtained by evaporating the solution to dryness, fusing with carbonate of soda, and treatment with aqua regia) were added to the portion, afterward to be again rendered workable by renewed treatment with chloride of barium. The operation of reduction is hastened by concentrating the fluid; in doing which care must be taken to guard against explosion, on account of the hydrogen. The separated metals were treated with aqua regia, and the platinum and palladium thus dissolved were separated from each other as above described. The traces of rhodium and iridium in the mother liquid can be removed entirely by continued boiling with iodide of potassium (whereby they precipitate as iodides) dissolved in aqua regia and added insoluble portion.

This insoluble and partly-oxidised portion was now again reduced in hydrogen gas, treated, as before described, with chloride of barium, and, after the removal of the barium, the last traces of platinum and palladium removed by boiling with caustic soda. Rhodium and iridium now alone remained to be separated.

The brown-red fluid was, for this purpose, evaporated with hydrochloric acid, and, after filtration, treated with bisulphite of soda—

$$\left(\begin{matrix}\mathrm{NaO}\\ \mathrm{HO}\end{matrix}\right\}\mathrm{S_2O_4}\Big)$$

in *great excess*, and the whole allowed to remain quietly *in the cold* for several days. The double salt of rhodium ($NaOSO_2,RhOSO_2$) separates slowly, giving a lemon-yellow precipitate. The solution becomes lighter and lighter, and finally almost colourless. The colour of the precipitate changes with that of the fluid, becoming, with it, lighter. This precipitate, upon washing, contained the rhodium almost pure.

Upon heating the fluid gently, a yellow-white precipitate separated, which consisted mainly of rhodium, but contained, also, some iridium. After filtering off this precipitate, the solution, upon being concentrated to a small volume, gave yet two precipitates—

1. A curdy, slowly-separating, yellowish-white precipitate, nearly chemically pure iridium, containing but the faintest traces of rhodium.

2. A heavy, crystalline powder, quickly separating, which was readily freed from the first by decantation, and weighed 16 grms. Upon testing, it gave all the reactions for iridium, but likewise some peculiar reactions not shown by the latter. It may possibly contain a new metal.

Exclusive of these 16 grms., the precipitate (the first) weighed 99·5 grms. The mother liquid was free from platinum metals. The complete separation of rhodium from iridium was accomplished by treating the yellow precipitates with concentrated sulphuric acid. They were brought in small portions into the acid, heated in a porcelain capsule until all the sulphurous acid had escaped, and then left upon the sand-bath until all the free sulphuric acid had been driven off; and the sulphate of soda formed. Upon boiling the mass of water, all the iridium dissolves as sulphate, with a chrome-green colour; while the rhodium remains behind as a flesh-red double salt of soda and rhodium oxide. It (the latter) was washed by boiling in aqua regia, and decanted with water. It is insoluble in water, hydrochloric or nitric acids, and in aqua regia. The rhodium and iridium are now completely separated. The rhodium salt weighed 33·2 grms.

The following are the weights of the various precipitates obtained from 1 kilo. of the original residue:—

	grms.
$KCl,PtCl_2$	117·5
PdI	77·0
KCl,PdCl	19·0
$NaOSO_3,RhOSO_3$	33·2
Ir_2O_3	9·1
Ru(+Ir)	4·5

The first yellow precipitate obtained in the cold by the bisulphite of soda, gave, by this treatment, the rhodium quite pure. The second and third precipitates, containing much iridium, gave a very fine rhodium, but still slightly impurified with iridium. The products, therefore, obtained by this treatment with sulphuric acid (which betray their impurification with iridium by their somewhat brownish colour) were collected for themselves, the rhodium separated therefrom by glowing, treated again with chloride of barium, and the operation of separation repeated. The green solution, containing only iridium, was gradually heated over an ordinary burner, in a porcelain capsule, and, afterwards, upon the sand-bath, to remove the excess of sulphuric acid; and, finally, the capsule and its contents were highly treated in a Hessian crucible. There is formed thereby sulphate of soda and sesquioxide of iridium. Upon boiling the mass with water, the last remained behind as a black, insoluble powder, which was readily washed by decantation. It weighed 9·1 grms.

In these operations, the new filtering apparatus and the continuous water-bath with which I have furnished my laboratory materially shortened the labour.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

January 20th, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President*, *in the Chair*.

The following gentlemen were elected Fellows:—I. Bell, A. Bird, G. R. Hislop, E. Lapper, H. Seward.

The first paper read was—"*Note on the Absorption of Mixed Vapours by Charcoal*," by John Hunter, M.A., Queen's College, Belfast.

The author, some time ago, published, in the *Journal of the Chemical Society* (May, 1868), the results obtained by absorbing the mixture of two vapours by means of cocoa-nut charcoal. He found that the absorption was increased when one of the vapours was at a temperature near to its point of condensation; and he explained the phenomenon by assuming that, when a fragment of charcoal is introduced into a mixture of two vapours, the one which is nearest to its point of condensation is first absorbed, and this, in its condensed state in the pores of the charcoal, aids the absorption of the other vapour. According to this view, a succession of condensations is going on. The theory is strikingly illustrated in experimenting with a mixture of water vapour and ammonia gas (obtained by heating an aqueous solution of ammonia of sp. gr. 0·88), when the mixture is much more largely absorbed than either the gas or the vapour separately. The mean of a set of experiments made at 100° and a mean pressure of 706·2 m.m. was—316·6 vols. of the mixture absorbed by 1 vol. of charcoal.

The President remarked that the results were entirely in accordance with what was expected on theoretical grounds.

The next communication was—"*The Composition of Iron-Rust*," by Dr. Crace Calvert.

The author had lately occasion to analyse rust obtained from two different places—from the outside of the Conway Bridge, and from Llangollen, North Wales; and he found both specimens to be composed as follows:—

Sesquioxide of iron	92·900
Protoxide of iron	6·177
Carbonate of iron	0·617
Carbonate of lime	0·295
Silica	0·121
Ammonia	traces
	100·000

This result induced the author to enquire to which of the constituents of the atmosphere the formation of rust is chiefly due. To this end, clean blades of steel and iron were put into tubes filled respectively with oxygen, oxygen and a little carbonic acid, oxygen and moisture, &c. The blades were introduced into the tubes, which then were filled, over mercury, with oxygen. But this proved an unsatisfactory method, inasmuch as always some globules of mercury remained adhering to the iron, whereby a galvanic action was produced, which, of course, induced a rapid oxidation. To avoid this, the tubes were filled simply by displacement of the atmospheric air. The blades were then left exposed to the action of the different agents for a period of four months. The results were as follows:—

Blades in dry oxygen.—No oxidation.

Blades in moist oxygen.—Out of three experiments, only in one a slight oxidation.

Blades in dry carbonic acid.—No oxidation.

Blades in moist carbonic acid.—Slight incrustation of a white colour. Out of six experiments, two did not give this result.

Blades in dry carbonic acid and oxygen.—No oxidation.

Blades in moist carbonic acid and oxygen.—Most rapid oxidation.

Blades in dry oxygen and ammonia.—No oxidation.

Blades in moist oxygen and ammonia.—No oxidation.

These facts led the author to assume that it is the presence of carbonic acid in the atmosphere, and not oxygen or water vapour, which determines the oxidation of iron.

The author next investigated the behaviour of iron in water into which, successively, oxygen, carbonic acid, a mixture of the two gases, &c., was conducted. The results were analogous to those above mentioned, inasmuch as the most effective oxidation took place when a mixture of oxygen and carbonic acid was introduced into the water. The action commenced immediately, and, in a short time, a dark precipitate covered the bottom of the vessel. The oxidation, in these cases, was not due to the fixation of the oxygen dissolved in the water, but to oxygen liberated from the water by galvanic action; the occurrence of hydrogen collected above the liquid in the bottles proved this sufficiently. A further evidence for the supposition that the oxidation of the iron is effected through the decomposition of the water is found in the fact that, when into distilled water which had previously been deprived of all its absorbed gases by continued boiling a bright blade is introduced, it became, in the course of a few days, here-and-there covered with rust. The spots where the oxidation had taken place proved to be impurities in the iron, which had induced a galvanic action, just as a mere trace of zinc, placed on one end of the blade, would establish a voltaic current.

Finally, Dr. Calvert investigated the state of iron in alkalies; and he discovered that, not only the solutions of the caustic alkalies, but of their carbonates as well, protect iron against any oxidising action.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 11, 1870.

E. W. Binney, F.R.S., F.G.S, *Vice-President, in the Chair.*

The Chairman said that he had observed, at Cheetham Hill, on the evening of Monday, the 3rd inst., at 7.30 p.m., a singular display of the Aurora Borealis. It consisted of an arch of white light, 4° to 5° in breadth, a little south of the zenith, extending from east to west, and passing through the Pleiades; and a column of deep crimson colour, nearly due north, extending from the horizon to about 40° altitude, having slightly the character of streamers. The white arch, also, moved slowly to the south. The intensity of the red colour in the pillar was greater than any he had previously observed.

Dr. Joule said he had not seen the aurora of the 3rd instant referred to by the Chairman; but, having been engaged on the same day in making observations with his new dip circle, he had noticed some remarkable disturbances in the magnetic dip, which no doubt were connected with the auroral display. He had also noticed similar disturbances of the dipping needle during the gale on Saturday, the 8th instant.

Dr. Joule exhibited his current meter, and with it, in connection with a galvanometer, made an experiment to determine the horizontal intensity of the earth's magnetism in absolute measure. The result gave 3·83 as the value of this element in the hall of the Society. The current employed was produced by a single cell of a Bunsen's battery.

MICROSCOPICAL AND NATURAL HISTORY SECTION.

January 3, 1870.

R. D. Darbishire, B.A., F.G.S., *in the Chair.*

Dr. W. Roberts exhibited some specimens of urinary calculi, composed of cystine; also some crystals of the same, obtained by evaporation in the open air of the ammoniacal solution. Six-sided plates of mother-of-pearl lustre were obtained in this way which formed brilliant objects for the microscope.

Dr. Roberts remarked on the great rarity of cystine calculi, many large museums not possessing a single specimen. He had, in his own collection, three specimens; and in the Museum of the Manchester School of Medicine, there were portions of two very fine calculi. A certain historical interest attached to one of the latter, a piece of which was presented, by the late Mr. Ransome, to Baron Liebig, during one of his visits to Manchester. The analysis of this piece led to the rectification of a curious error in the original formula for cystine, published by Prout and Lassaigne. These eminent chemists had deduced the formula $C_6H_6NO_8$; but the Giessen analysis discovered 20 per cent of sulphur, which brought the true formula to $C_6H_6NS_2O_4$, the 2 atoms of sulphur having been before erroneously reckoned as 4 atoms of oxygen.

Mr. J. Sidebotham read "*Notes on the Pupa and Imago of Acherontia atropos.*"

Mr. W. Boyd Dawkins sent, for exhibition, some very interesting microscopic sections of *Eozöon Canadense*, which are the more valuable as being those which have passed through the hands of Sir W. E. Logan and Dr. Carpenter.

Mr. J. B. Dancer, F.R.A.S., presented the Section with a box containing twelve new polarising objects. These partly consisted of some of the hard fatty acids, which form very effective objects, and partly of crystallisations of some of the hydrocarbon compounds, which compete with the best specimens of polarising objects of the present day.

[English Edition, Vol. XXI., No. 531, pages 42, 43]

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

The ordinary meeting of the Chemical Section was held on Monday last, Mr. Alexander Whiteland, Vice-President, in the Chair. After the admission of some new members and the transaction of some other business, a paper was read by

Mr. J. Wallace Young. "*On Artificial Alizarine.*" He characterised madder and its preparations as being among the most useful dye-stuffs used in calico-printing and dyeing. The importance of madder is due to the fact that with different mordants it gives a great variety of colours,—iron mordants giving all shades from black to delicate purple; those of alumina giving colours from a dark red to a fine pink; and a mixture of them giving various shades of chocolate. Madder root has undergone probably more chemical investigation than any other colouring matter—the investigators being Robiquet and Colin, Claubry, Persoz, Runge, Schunck, Higgin, &c. The most important colouring matter is alizarine; from it may be obtained all the durable and brilliant colours yielded by madder itself. Mr. Young described the method by which alizarine may be obtained readily from madder root, and mentioned that the substance appears ultimately as a sublimate of fine orange-red needles, which are slightly soluble in hot water, and readily soluble in boiling alcohol. Owing to the high price of madder and madder preparations, much interest attaches to every substance which purports to be a substitute for madder. A good substitute would be gladly welcomed. M. Roussin announced a few years ago that he had succeeded in obtaining artificial alizarine from naphthaline, but further investigation proved that he had been mistaken. More recently, it had been announced in the Chemical News and elsewhere that artificial alizarine had been successfully obtained from anthracen.

Mr. Young then stated the results of his experiments upon two madder substitutes, one of continental manufacture, a thin dark coloured paste containing 5·7 per cent of dry residue, the other of English manufacture, supplied in the form of an opaque brownish liquid. The former contained a large amount of coloured matter, but further purification was necessary before it could be used as a madder-substitute. When mordanted cloth dyed with it was boiled with solution of soap, the colours were found to be rather fugitive. Cloth prepared for Turkey-red absorbed the dye-stuff readily, but the same want of fastness was observed. When mixed with iron and aluminous mordants, and printed on in the way in which madder extract is used, the colours were found to be dull and not sufficiently fast A sublimate obtained from the dried paste closely resembled natural alizarine, but was rather lighter in colour. It dyed mordanted cloth well and withstood treatment with soap. The English made madder substitute yielded a red rather yellower than that yielded by natural alizarine, a black of equal, if not superior quality to madder-black, but the chief difference was in the purple, which was rather slate-coloured than anything else, contrasting most unfavourably with the fine shade of colour given by madder. The yellowness of the red seemed to depend pretty much on the proportion of tin salt used in the clearing. As with madder and its preparations, the development of the colouring matter of the artificial alizarine is increased by tanning materials, as sumac, and deteriorated by chalk. The dried residue of the brown artificial alizarine liquid yielded by sublimation a crystalline body of a yellower shade than that of the crystals of the natural alizarine. In order to compare the artificial alizarine with the natural substance and with purpurine, which is another madder extract, the author dissolved each of them in weak ammonia, and added barium-chloride; they all yielded purplish precipitates. The natural alizarine precipitate was of a fine bluish-purple colour, and the supernatant liquor was almost quite clear; that from the artificial product was much redder, and the supernatant liquid was highly coloured; the purpurine precipitate was of a purplish-red colour. The natural alizarine and purpurine precipitates did not seem to be much affected by being washed several times with cold water, but the artificial alizarine precipitates gradually dissolved in the washing water and finally disappeared. Mr. Young thoroughly tested the dyeing powers of the new alizarine by comparing the results produced upon mordanted cloth either with equal weights of sublimed alizarine obtained from the two artificial preparations and from madder, and of purpurine; he showed the specimens of cloth so treated. Instead of the dark full red given by the natural substance, the artificial alizarine yielded only a yellowish-red, much like that of the purpurine. Its purple was of a slaty tint, but the chocolate and black differed very slightly from those of the natural alizarine. The purpurine scarcely gave any purple, and the same is true of the Continental and English madder-substitutes. Alcoholic solution of natural alizarine gives a fine purple colour with copper acetate, and with the same reagent the artificial preparation gives a very red purple. No characteristic bands appear in the spectrum when artificial alizarine is used, and, therefore, purpurine is shown to be totally absent. The author was not aware if anything had been done towards establishing a formula for the new alizarine, but, his opinion arrived at after performing many practical experiments, was that there was some essential difference between the artificial and the natural substance. He had found no superiority in the new substance. In a supplement to the paper of which the foregoing is an abstract, Mr. Young said that the manufacture of artificial alizarine is carried out in two or three ways by continental chemists, and from the examination which has been made of the products, it would appear that some of them consist of a mixture of alizarine and purpurine, in different proportions, and some of alizarine, or of a substance intermediate between the two. It had been said that it was more advantageous to use the artificial alizarine as a dry paste, rather than in the dry state, but he could find no difference in the dyeing power. He had treated the artificial alizarine with boiling dilute sulphuric acid, as in garancine making, afterwards washing thoroughly and drying: he had also dissolved it in sodium carbonate, precipitating with acetic acid, washing, and drying; but the colours given on drying did not seem to be modified in any way.

A discussion followed, in which several gentlemen took part. There seemed to be much doubt as to the mode of preparing the artificial alizarine, and if it could be produced in large quantity, considering the small amount of anthracen which exists in coal-tar. On that point, however, it was stated by Mr. Hogg that it could be supplied in considerable quantities and at such a price as would make it cheaper than madder.

A paper then followed "*On the Estimation of Iodine and Bromine in the Mother Liquors from Saltpetre and in Kelp*," by Dr. Clark. The author submitted a process by which the tediousness may be avoided which attends most of those which aim at estimating iodine and bromine existing in the combined state in presence of a large excess of chloride. He considered it specially applicable for the estimation of iodine and bromine in the mother liquors from saltpetre. A measured quantity of the liquor is introduced into a long tube with twenty alkalimeter measures of bisulphide of carbon; and nitrous-sulphuric acid (prepared by passing nitrous acid through sulphuric acid) is added, drop by drop, till iodine ceases to be liberated. The tube is inverted several times after the addition of each drop of acid, in order that the iodine may at once be dissolved by the bisulphide of carbon, to which it gives a violet colour, varying in intensity with the amount of iodine in solution. The quantity of the iodine is estimated by comparing the degree of the colour with that which results when a standard solution of iodide of potassium is used in the same way. The author affirmed the delicacy of the reaction to be such, that 0·01 gr. would communicate a distinct rose tint to the bisul-

phide of carbon. When the amount of iodine exceeds 0·2 gr. of iodine in the quantity operated on, a difficulty occurs, as the violet colour becomes so deep that the various shades cannot be distinguished with accuracy. When all the iodine is separated by the bisulphide of carbon, the solution containing the bromine is introduced into another tube, and the bromine is liberated by chlorine-water in the usual way, and taken up by a fresh quantity of bisulphide of carbon. In this case, an orange colour is the result, and the amount of bromine may be estimated by comparing the colour with that resulting when a solution of bromide of potassium is used of known strength. A sample of saltpetre mother liquor treated in the way mentioned gave the results—

Iodine.....	145·3 grs.	per gallon.
Bromine.....	2094·5 "	"

The same process, slightly modified, may be used to determine the amount of iodine and bromine in kelp.

Mr. Stanford said that, so far as iodine is concerned, the process mentioned by Dr. Clark was a good commercial process, but he doubted if it would be of use with bromine.

Mr. Tatlock considered that the process was not specially novel, and that it was liable to the same objections that apply to colour tests generally. He could put little or no confidence in such tests.

NOTICES OF BOOKS.

Elementary Chemistry. By the Rev. William Grist Grammar School, Bewdley. Part I.—*The Elements* Birmingham: Cornish Brothers. 16 pages; 8vo.

This author of this work, imagining, we suppose, that there was a great dearth of elementary works on chemistry, determined to bring his own grist to the mill. We are greatly surprised that he could find a miller to grind it, and we pity those who may attempt to eat the bread which has resulted; for, without the least doubt, it will disagree with the first person who partakes heartily of it.

We have an account of the elements (which, the author informs us, "are more than sixty in number, more than fifty of which are metals") compassed in a span of sixteen small octavo pages. We can easily imagine how lengthy and lucid the descriptions of each element must be. For example, strontium receives the following amount of notice:—"This greatly resembles barium, but its salts are not poisonous. One of its salts is used in red fire." While molybdenum has nearly a line devoted to it—"Molybdenum is white, brittle, and very infusible." What an example to prolix writers! What can be more terse than the above?

Now, as an example of the author's English, we may as well quote the first paragraph in the book:—"Chemistry is the science that has for its object the discovery, nature, properties, and combinations of the elementary substances, and also the laws which govern the production of their combinations." Again, in speaking of the non-metallic elements, he remarks, with singular perspicuity, "These may be divided into three groups—invisible gases, chlorine group, and (excepting iodine) solids." As to the author's Latin, he gives *Hydrargyrus* as the term for mercury. As to his general accuracy, he informs us that iodine is "obtained from the ashes of seaweed, after the soluble parts have been extracted;" that sulphur "melts at a little above the boiling point;" that the specific gravity of potassium is 0·086, of sodium 0·097, and of lithium 0·059; that sodium "becomes red-hot when it touches cold water, and burns with a bright yellow flame if the water be hot;" that "fire appears to be the effect of violent combustion." We will cease here. We will not ask how, when, and where the author studied chemistry. We will not ask what has induced him to rush with such inconsiderate haste into print. We will not ask the aim, object, design of the work before us. But we will ask him if he is aware of the spirit which is abroad among our schools in regard to science teaching; if he knows of the many accurate, concise books by eminent men, written specially for the requirements of our schools; if he recognises the injury which he is doing by making public false science, inexact method, the truths of nature perverted by a sojourn in the caves of his mind, and returned maimed into the light of day.

At a time when the desire for sound training in science is becoming general, a work of this nature does infinite harm, and brings the contempt of the public both upon the science and its teacher. We recommend Mr. Grist to give up writing on chemistry; to devote as much time as he can spare to the study of it for the next twelve months, and then, if need be, to teach it by the help of some good work specially adapted for schools—such as the work of Roscoe, of Bloxam, of Harcourt and Madan, of Barff, &c.

Chemistry for Schools, an introduction to the Practical Study of Chemistry. By C. Haughton Gill, Assistant Examiner in Chemistry at the University of London. 100 Illustrations. London: James Walton, 1869. 315 pages.

This work is intended to be used as a manual for schools where chemistry forms a part of the ordinary routine work; and one of its main objects is the cultivation of "scientific habits of thought." It does not appear to differ materially from any of the many class-books which have appeared during the last few years; it is most nearly related to Dr. Williamson's "Chemistry" (Clarendon press series), and his nomenclature is followed. The text is somewhat uneven, and in another edition should be carefully examined; in one portion it is turgid, in another, rugged and clumsily constructed; thus the "*genesis* of ammonia," and the "change of proportional composition" is described in one place, while in another, we find such expressions as "got rid of," "a *bit* of this, a *pinch* of that," "the wood is re-lit with a little pop," "To do this, it is necessary to act on it by other bodies, which must be admitted to be what they are described to be," and so on. All this, however, refers to the diction only; the subject matter appears to be sound and well arranged. There is evidence of much hard work, and the book is eminently comprehensive; otherwise it is admirably printed, and of very convenient form, and we should be sorry to regard it as labour lost. The work is divided into twenty-two chapters; to each of which is appended a list of questions. The appendix contains a very useful chapter on "crystalline systems," illustrated by woodcuts of the typical forms. There is also a chapter on the metric system, by Mr. Walker, one of the Mathematical Masters in University College School, in which we find ready rules for various conversions; thus—"To convert kilomètres into miles, multiply by 5 and divide by 8. To convert mètres into yards, multiply by 35 and divide by 32. To convert decimètres into feet, divide by 3. To convert centimètres into inches, multiply by 4, and reject the last figure. To convert millimètres into inches, or decimals of the inch, multiply by 4, and point off the last two figures. To convert miles, yards, feet, inches, into metric equivalents, multiply by the divisors, and divide by the multipliers, as given above."

The Examination of Petroleum and other Mineral Oils according to the Petroleum Act, 1868. By A. Norman Tate, Analytical Chemist, &c., &c. London: H. Greenwood. 1869.

The author of this small pamphlet has, we think, done good service to all who have in any way to do with petroleum or other mineral oils, by writing this very clear paper on a subject which, as is justly pointed out by its experienced author, is not so well defined as it ought to have been. The paper contains valuable and definite directions about the testing or ascertaining of what is termed the *flashing point*. We recommend the perusal of this pamphlet to all parties in-

terested in this subject, and especially to those who by the Act are called to carry out the operative tests, viz, the inspectors of weights or measures, or other persons duly appointed to inspect weights and measures as testers of petroleum. We entirely approve of the author's remarks made on this score.

A Manual of Diet for the Invalid and Dyspeptic, with a few Hints on Nursing. By Duncan Turner, Licentiate of the Royal College of Physicians, &c., &c. London: John Churchill and Sons. 1869.

The object the author has sought in publishing this small essay is to convey, in a few words, avoiding as far as possible technical terms, necessary information to a larger class than would be expected from the title of the book, which contains six chapters and an appendix of formulæ. We find that the volume contains, written in a popular language, a great deal of useful hygienic information, and we heartily recommend it to all households, where, especially in the hands, or better still in the head, of the mistress, this useful knowledge deserves a permanent place. The appendix is highly commendable for its sound directions as regards the preparation and cooking of food, which has more to do with digestion than is commonly supposed in this country.

Addresses at the Inauguration of Charles William Eliot as President of Harvard College, Tuesday, October 19, 1869. Cambridge (Mass.): Sever and Francis. 1869. 65 pp., 8vo.

On the 19th of September, 1868, Dr. Thomas Hill resigned the office of President of Harvard College; and on the 19th of October, 1869, Mr. Charles William Eliot was formally inducted into office in his stead. Mr. Eliot is known to many of us as a writer on chemistry: to some of us as a man of singularly sound and accurate thought, of high culture and of liberal views, and as a kindly genial gentleman. Let us glance for a moment at the addresses which were delivered at the inauguration of Mr. Eliot, and specially at his own, which derives additional interest from the fact that he has paid special attention to the subject of education, and has watched the growth of the educational system of his own country, comparing it with those of the principal European nations, and particularly with our own college system.

The form of induction into office of the president of a college is very different in America from that which is adopted in England. In the invitation to the Alumni of Harvard College, it is stated that "A procession will be formed in Gore Hall, at half-past two p.m., under the direction of Leverett Saltonstall, Esq, and the exercises in the Church will begin at three o'clock p.m. Immediately after the exercises in the church, President Eliot will hold a reception at the President's House in Quincy Street." The "Exercises" on this occasion were nine in number, and consisted of:—

1. "Music by the Band.
2. Choral: 'Let us with a gladsome mind.'
3. Prayer by the Rev. Dr. Peabody.
4. Congratulatory Address in Latin, by John Silas White, of the Senior Class.
5. Induction into Office, by John Henry Clifford, President of the Board of Overseers.
6. Chorus: 'Domine, salvum fac Præsidem Nostrum.'—J. K. Paine.
7. Address by President Eliot.
8. Chorus from the Antigone of Sophocles: 'Πολλα τα δεινα κουδεν ανθρωπου δεινοτερον πέλει.' 'Wonders in Nature we see.' —Mendelssohn.
9. Benediction, by Rev. Dr. Walker."

The Latin address is, as we should expect, less florid and elaborate than those which are given on somewhat similar occasions in the French and German Universities; the 'Amplissimi, Nobilissimi, Præstantissimi Eminentissimi," commencement is omitted, and it begins simply and to the point, "Convenimus hodie," while it is concluded by an exceedingly apt and reverent phrase:—"Precamur autem a Deo Optimo Maximo ut signis illis venustis ac pulchris, quæ verbo inter se discrepantia, re prorsus unum videntur sonare, semper tu et nos, ut diligimus, sic utamur,—'Christo et Ecclesiæ' atque 'Veritas.'"

In the Inductory Address, Mr. Clifford alludes to certain changes recently made in the constitution of the College—notably, the separation of the College from the State—a change "which has wisely taken from the Legislature and confided to the Alumni of the College, the choice of the Board of Overseers." It has also given the College a greater independence, since it now stands alone, unsupported by the State, and is dependent upon itself for the maintenance of the position which, as the oldest American University, it ought to occupy. Mr. Clifford then speaks of the power committed to the President, and of the nature and result of his influence upon the Alumni: he advocates a system of "personal examination, by which the Faculty might test the student's disposition to make the best of his opportunities, according to his capacity," in place of the unjust system of arbitrary marks by which mediocrity is too often crushed out by genius. "Mediocrity," he truly remarks, "is the unattractive average of the race; though its capabilities, wisely stimulated and diligently cultivated, constitute the working forces of the world. Genius, with its brilliant, but often erratic efforts, is the rare exception in human endowment. The former needs all the fostering and patient care the teacher can bestow; the latter is self-reliant and sufficient unto itself." When the Fathers of New England who founded Harvard College inscribed Veritas upon its seal, to which was soon added Christo et Ecclesiæ, "they surely never dreamed," says Mr. Clifford, "that there is an irrepressible conflict between the truths of ethical and physical science."

Passing now to the address of the new President, let us notice the treatment of matters of faith and reason, considered in regard to an educational system, by a man of great general, and of special scientific culture. The President (and he here speaks also of the University) allows no antagonism between literature and science; he makes no distinction. Instruction is not to be specialised—it is to be general, and the University is not concerned with applications of knowledge: "truth and right are above utility in all realms of thought and action." The subject-matter of learning must be augmented, not diminished. In America specially learning must be broadened and invigorated, for it will require many generations before it will bear pruning. "Recent discussions have added pitiful little to the world's stock of wisdom about the staple of education. Who blows, to-day, such a ringing trumpet-call to the study of language as Luther blew? Hardly a significant word has been added in two centuries to Milton's description of the unprofitable way to study languages. Would any young American learn how to profit by travel, that foolish beginning but excellent sequel to education; he can find no apter advice than Bacon's. The practice of England and America is literally centuries behind the precept of the best thinkers upon education." The problem is not what to teach, but how to teach. With an improved system, Mr. Eliot thinks that a man of twenty-five ought to have a good general knowledge of all the main subjects of human knowledge, and a thorough knowledge of the one subject which is to engage his professional after-life. There are special modes of thought belonging to each special branch of learning, and a young man ought to have some actual experience of each.

As to the subjects taught in the American universities, Mr. Eliot tells us that the course of study has of late been enriched and enlarged. "The University believes in the thorough study of language. It contends for all languages—Oriental, Greek, Latin, Romance, German, and especially for the mother-tongue; seeing in them all one institution, one history, one means of discipline, one department of learning. ... The University recognises the natural and physical

sciences as indispensable branches of education, and has long acted upon this opinion; but . . . . . the prevailing methods of teaching science, the world over, are, on the whole, less intelligent than the methods of teaching language. The University would have scientific studies in school and college, and professional school develop and discipline those powers of the mind by which science has been created and is daily nourished—the powers of observation, the inductive faculty, the sober imagination, the sincere and proportionate judgment." He next speaks of mathematics, of history, of mental, moral, and political philosophy. The latter of these should not be taught with authority, because they are full of disputed matters, and because "exposition, not imposition, of opinions is the professor's part."

The admission — or, as we should say, matriculation — examination at Harvard College is something similar to the first examination in the University of Paris; but, for the first degree in Arts, no less than four years' study are requisite. We have another proof of the difficulty of obtaining this degree in the fact that one-fourth of the total number of students who enter the College fail to take it. Of these four years, the first is devoted to certain fixed subjects, through which all freshmen pass; but, during the other three years, more than half the time is given to subjects chosen by the student from lists. Six studies may be thus chosen for the second year, nine for the third year, and eleven for the fourth year of college life. This so-called "elective system" has been found to work well, and President Eliot proposes to extend it. Harvard possesses among her students men of the most varied conditions in life, and of the most varied means. Many men enter yearly without any resources at all; but, so long as they exhibit aptitude for learning, and are of good character, they are never refused admission on account of their poverty. Every year, a sum of more than 20,000 dollars is expended in helping poor students to complete their university education; and, in addition to this, there are many private grants of money. "No capital," says Mr. Eliot, "earns such interest as personal culture. . . . . The poverty of scholars is of inestimable worth in this money-getting nation. It maintains the true standards of virtue and honour. The poor friars, not the bishops, saved the church."

Harvard College is governed by the Board of Overseers, the Faculties, and the Corporation. During the last three years, the overseers have been chosen by the Alumni, and five are elected each year to serve for six years. Their duty is to inspect the University, and to watch the actions of the President and Fellows. The Corporation makes all appointments, fixes salaries, and acts as Treasurer. It holds all public trusts and grants, and invests all unemployed moneys of the University. It should always be seeking "how safely to make a quarter of a per cent more: a quarter of one per cent means a new Professorship." The President is a member both of the Board of Overseers and of the Corporation, as, also, of all the Faculties. His chief duty is that of supervision; he has, further, to advise the Corporation in the matter of appointments. As regards the teachers: "the Corporation demands of all its teachers that they be grave, reverent, and high-minded; but it leaves them, like their pupils, free." A University is built, not by a sect, but by a nation.

Here, then, we have, in brief, the outlines of the mode of working of a university "intensely American in affection, and intensely democratic in temper." We can scarcely attempt here so large a scope as a comparison of it with our own or foreign universities, for the character of such an institution is always profoundly influenced by the character and conditions of the people for whom it exists. A strict comparison on equal terms hence becomes impossible, and a comparison, without an even balance of existing influences and qualities, unfair. Yet we would presume to say that many of our European universities might, with advantage, adopt some of the regulations of Harvard; and that a reverse interchange would be beneficial is admitted by the New England Cantabs themselves. Harvard University has grown greatly during this century, and we doubt not but that it is destined to play an important part in the culture of the New World. The new President, whose life has been linked with that of the University, whose judgment has been ripened by travel and by residence in Europe, and who possesses a singularly healthy tone of thought, combined with refined intellectual tastes, has been well chosen for the furtherance of this destiny.

Géologie Comparée: Etude Mineralogique du fer Météorique de Deesa. Par M. Stanislas Meunier, Docteur ès Sciences, &c. Paris: F. Savy, 24, Rue Hautefeuille.

This pamphlet is a reprint of a series of articles which have appeared in *Cosmos*. The headings of the chaptess are:— "Description and Chemical Analysis of the Iron of Deesa;" the latter name refers to a locality in the Cordilleras Mountains, in Chili. "Mineralogical Analysis of the Meteoric Mass;" from this portion we learn that the meteorite referred to contains no less than eleven different well-defined mineralogical species. "Comparison of the Deesa Meteorite with Divers Types of Meteorites." "Conclusions Drawn from the Investigation;" this portion of the paper informs us that it is possible to come to some knowledge of the geological age meteorites belong to, since the author states that our globe contains what he terms eruptive meteoric rocks. The Deesa meteorite is stated to be remarkable, because it is the first instance met with of an extra-terrestrial dyke (*filon*). The pamphlet is well printed, and is issued on a better kind of paper than is usual with our courteous French neighbours.

CORRESPONDENCE.

Gmelin's Chemistry.

To the Editor of the Chemical News.

Sir,—It is known, no doubt, to all your readers that the Cavendish Society has been for some years defunct, and that their works are understood to have been handed over to their publisher, Mr. Harrison, of 59, Pall Mall. That gentleman has since issued the two last but one volumes of the translation of "Gmelin's System of Chemistry," which, at the demise of the Society, was incomplete. But the last volume (vol. xviii.), which is to contain the index, is not yet published, nor does there appear any certainty when it will be, if ever.

Yet, in the absence of this index volume, this magnificent work is almost useless to chemists for reference. Two or three years having elapsed without any progress towards our attaining this index being apparent, may I enquire whether Messrs. Harrison have any copyright in this work, and if not, suggest that it would, probably, be worth the while of some other publisher to set vigorously about producing the index to Gmelin.—I am, &c.,

Reference.

January 11, 1870.

Sampling of Cargoes of Phosphatic Raw Materials.

To the Editor of the Chemical News.

Sir,—It has now become a settled practice to fix the price to be paid per ton according to the percentage of tribasic phosphate of lime found by analysis. Samples are usually sent to two chemists, and, for their convenience, sent in fine powder. The seller or his agent suggests that, to procure this powder, the material should be passed through millstones; and some manufacturers are unwise enough to consent to such a vicious practice, which goes far to explain the

well-known fact that, given a certain quantity of material stated to contain a certain percentage of phosphate of lime, you can never obtain, in the manufactured article, the amount of phosphate you had a right to expect by calculation. In the action produced by the process of grinding, great heat is evolved, which heat proceeds from the moisture which is thus, to a certain extent, used up, and disappears; and thus it is not unfrequently found that 1, 2, or 3 per cent of moisture disappears, and the phosphates, consequently, are increased in the analysis. We have long expected that analytical chemists, who must have been well aware of the injustice, would have come forward and proposed a remedy; but they have not done so; and, lest it may be supposed that it is a necessary evil, and there is no cure, we beg to suggest one or two modes by which the injustice can be removed.

1. While the cargo is being discharged, let one weighing in fifty be placed over a kiln or some convenient drying-place, and thus a great portion of the moisture dried off and ascertained. Most manufactories afford convenient means for accomplishing this, which can be done by the sellers and buyers' agents, and during the discharge of the cargo. Suppose 5 per cent of moisture is thus driven off, then the phosphate found in 95 grs. of such sample will represent that which exists in 100 grs of the cargo. There will then be no objection to passing the dried sample through stones. This mode is particularly suitable for wet cargoes; but, in a case where this drying cannot be conveniently accomplished,

No. 2 plan may be adopted, which is either to send rough samples to the chemist or, if, for their convenience, a fine sample is wanted, to send a rough sample with it at the same time, from which the chemist should ascertain the moisture. In all cases, as the moisture resides mostly in the fine part of the cargo, it is desirable to pass the sample lot through a screen, and then, by weighing each separately, to ascertain their respective proportions, and then taking care that the sample for analysis should be made up in the same proportion—say one of fine, and two of rough, as the case may be.

3. There is yet another mode of dealing with the difficulty, and that is for the seller to allow the buyer 1 or 2 per cent, according to the dampness of the cargo, for the privilege and convenience of allowing the whole to be ground under stones.

Here, then, are three methods, each fair to both parties, and vastly preferable, we think, to the unjust system frequently pursued and which often leads to disputes.—We are, &c.,

Spooner & Bailey.

Gmelin's Chemistry.

To the Editor of the Chemical News.

Sir,—In reply to the letter signed "Reference," which appeared in your last number, and for the satisfaction of many persons who are interested in the completion of Gmelin's "Handbook," I beg to be allowed to make the following statement.

About 200 pages of the concluding volume are already translated; but, for the remainder, we have to wait the pleasure of the German editor and publishers, whose movements are not very expeditious. The conclusion was promised last year, but has not yet appeared; when it comes to hand, the translation will be completed with all possible despatch.

The much desired index is in progress, and a considerable portion is already compiled; but its completion must, of course, depend on that of the work itself.—I am, &c.,

Henry Watts.

151, King Henry's Road, N. W.
January 17, 1870.

Presence of Lead in Wine.

To the Editor of the Chemical News.

Sir,—This week's Chemical News contains a paper by Professor Storer, "On the Simultaneous Occurrence of a Soluble Lead Salt, &c., &c., in Sherry Wine." This paper will lead many to believe that the addition of litharge and sulphuric acid to wine is by no means a rare occurrence, and may thus needlessly alarm some, and cast an undeserved slur upon others. I would, therefore, with your permission, make a few remarks on the above paper.

The addition of litharge to wine, for the purpose of removing acidity or for any other purpose, is, I believe, never practised at the present day, if, indeed, it ever was a practice. The belief that such a practice exists is nothing more than an old tradition, kept alive by the occasional finding of lead in some sample of wine.* In most or all of these cases, when properly investigated, the presence of lead may be proved to result from carelessness, and is not due to wilful addition of litharge for purposes of improvement; indeed wine could not be thereby improved. For instance, the wine has been run through leaden pipes; has been filled into bottles cleaned with shot, some of which have stuck in the bottle; or has, in some other similar manner, come into contact with lead, and been impregnated by it.

Again, the presence of small quantities of free sulphuric acid is of very frequent occurrence in sherry, and, in fact, in many other wines. Its presence is easily accounted for without the hypothesis of its addition for the purpose of removing lead. It is now well known that plaster-of-Paris is very frequently added to *must*, and its action on cream of tartar yields tartrate of calcium, sulphate of potassium, and sulphuric acid, part of the latter remaining free if the other salts are not sufficient to neutralise it.

Lastly, the solubility of sulphate of lead in tartrate of ammonium is a well-known fact, and has been long employed in analytical chemistry for the purpose of separating sulphate of lead from sulphide of mercury and sulphur.—I am, &c.,

A. Dupre, Ph.D.

Westminster Hospital,
January 15, 1870.

The Cavendish Society.

To the Editor of the Chemical News.

Sir,—It may be satisfactory to many of the old members of the Cavendish Society to be informed that the Society is not extinct. I was present at the last public meeting, held under the presidency of Mr. Graham, when it was resolved—1. To accept the offer of Messrs. Harrison to relieve the Society from its liabilities, and to complete the translation of "Gmelin's Chemistry," including a full index, on the condition that the Society surrender to Messrs. Harrison the remainders of the works issued by the Society (already printed and published by Messrs. Harrison), and also the right of sale, at a stipulated price, of the volumes required to complete "Gmelin's Chemistry." 2. That the President, Council, and Secretary, hold office until this engagement with Messrs. Harrison be fully carried out.

Mr. Watts has already explained the cause of the delay in the completion of "Gmelin." Subscribers will see that their interests have been cared for by the President and Council. The Council can meet, at any time, with full powers to act. Should such a meeting be necessary, their first duty will be a melancholy one, namely, to elect a new President, and then, having agreed that the engagement with Messrs. Harrison has been fully carried out, to dissolve the Society.

* *Query.* Has the name *sugar* of lead, by which acetate of lead is popularly known, anything to do with this belief in the use of litharge as sweetening matter?

Although a member of the Council, I have no official authority whatever for making the above statement, nor do I know of any means, short of summoning the Council, for procuring such a statement. But as so many inquiries and complaints have been made respecting the present position of this Society, I trust it will not be thought impertinent if I thus supplement Mr. Watts's letter. I am, &c.,

C. Tomlinson.

Highgate, N., Jan. 24, 1870.

Gmelin's Chemistry and Watts's Dictionary.

To the Editor of the Chemical News.

Sir,—Every chemist and possessor of "Gmelin's Chemistry" will, I am sure, in common with myself, be glad to have seen Mr. H. Watts's letter in the last number of the Chemical News, and to hear that there is at last a chance of this very valuable work being completed.

Whilst on this subject, I would refer to Mr. Watts's "Dictionary of Chemistry," and should like to know if there is any probability of the hint being acted upon, which, I believe, you originated at the time this latter work was completed—viz, the annual publication of a supplement which would contain the contributions to chemical science for the year preceding. Such a book is published in Germany, and is a great boon to all chemists; but, with a work like Watts's "Dictionary" as a starting point, the further labours of its eminent compiler, than whom there is no one more competent, would be much more valuable.

I am sure that all my brother chemists would only be too glad to purchase the book at a price which would well remunerate the publishers.

John G. Dale.

Laboratory, Mersey Bank,
Warrington, January 22nd, 1870.

OBITUARY.

A. PAYTON HURLSTONE.

We record, with pain, the death of a valued friend and talented contributor to the Chemical News. Adam Payton Hurlstone, M.R.C.S., M.B., B.Sc., &c., died on the 21st of December, in the 24th year of his age, on board the steamship *Laplace*, on his passage from Brazil, where he had been pursuing his studies in botany, geology, &c.; he was buried the same day, at sea. Since leaving Cheltenham Grammar School, Mr. Hurlstone's scientific and medical studies had been pursued at University College, where he distinguished himself by carrying off, at an early age, the highest prizes for which he competed. It is to be feared that his unremitting devotion to study, acting on a frame not naturally robust, sowed the seeds of premature disease; and, with a view of combating unfavourable symptoms, he was advised to try the effect of foreign travel and sea voyages. We had great hopes that his health would, by this means, have been restored, and that he would soon have been enabled to continue that career of usefulness of which his talents gave such ample promise. At one time he was a frequent contributor to the Chemical News, and some of the best reviews and unsigned articles which have ever appeared in these pages were from his pen. His relatives wish to take this opportunity of intimating their great loss to his many scientific friends.

MISCELLANEOUS.

New Food Journal.—We perceive with pleasure that Messrs. J. M. Johnson and Sons, of Castle Street, Holborn, announce their intention of bringing out a new and cheap periodical, called the *Food Journal*, to be devoted entirely to the very important subjects of Food and Public Health. These two great questions are so prominent now-a-days, and embrace so many details of personal interest, that we cannot, even on purely selfish grounds, refuse to listen to them, especially when put before us in any other but a professional and technical guise. The adulteration question will be largely and carefully dealt with, and many of the leading sanitary writers of the day will contribute to the pages of the Journal.

The Troppmann Trial.—One of our correspondents has the kindness to call our attention to a portion of the evidence of Prof. F. Roussin, which we translate. Speaking of the abdominal viscera of the corpse of Jean Kinck, this well-known chemist says—All the viscera, except the stomach and duodenum, are in full state of putrefaction; the internal parietes of the stomach exhibit a slaty colour, which had not penetrated into the tissue of the organ itself. On more minute examination being made, it was found that there were two distinct colours—one black, due to sulphuret of iron, and one blue, distinctly due to Prussian blue; the latter was detected with certainty, and this was sufficient evidence of the previous presence of hydrocyanic acid. The liquids of the stomach contain, moreover, a very large proportion of an alkaline sulphate, and in such large quantity as it never otherwise occurs in that organ. The Professor accounts for the presence of the three substances named by the rudimentary mode employed by Troppmann for the manufacture of hydrocyanic acid. The method is described as follows:—The convict used two retorts—one smaller, the other larger—the latter serving as receiving condenser. He used ferrocyanide of potassium and dilute sulphuric acid to prepare the hydrocyanic acid from, but was unable to prevent the formation of incrustations of sulphate of potassa and sulphate of iron; hence, irregularity ensued in the boiling of the liquid, and, along with the hydrocyanic acid, sulphate of potassa and sulphate of iron spirted over. In addition to these impurities, there was formed a white substance, which turns blue on exposure to air; and that substance has also been found in the stomach. Some of the Prussian blue found in Kinck's stomach was handed round to the jury at the trial.

The Royal Mint.—Mr. W. Chandler Roberts, F.C.S., As.R.S.M., has been appointed chemist to the Mint. We call attention to this with the greater pleasure because it is a new chemical appointment in connection with the Government. The laboratory will, we believe, be partly devoted to research—the first laboratory of this sort established by the Government. Mr. Roberts was for some years assistant to the late Professor Graham, and associated with him in hydrogenium researches; we, therefore, hope that Mr. Roberts will continue his experiments on this subject, and that this new recognition of science on the part of the Government may lead to many useful discoveries.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Revue Hebdomadaire de Chimie, December 16, 1869.

Aniline Blue.—M. Blumer-Zweifel.—When either the tartrate or hydrochlorate of aniline is brought under the influence of oxidising substances, it produces on tissues an

intensely black colour; by a somewhat analogous process, the author obtains a blue which is stated to be as good as indigo blue. For printing, 100 grms. of dry starch are mixed with a litre of boiling water, to which is added 40 grms. of chlorate of potassa, from 3 to 4 grms. of sulphate of iron, 10 grms. of chloride of ammonium, and, after this mixture is cold, 60 grms. of the aniline salt.

Vesuvine.—M. Knosp.—Under this name, the author has brought into commerce a dye material belonging to the class of aniline dyes; but no further particulars are mentioned, as regards the preparation, or mode of obtaining the dye, which is reported to be sold in the state of paste and powder. This dye yields shades of bright, as well as deep orange and bright brown, and is suitable for dyeing silk, wool, and cotton; but this latter fabric has to undergo a series of mordanting processes before it is in proper state to receive the dye.

Carbon-Japanis.—Under this appellation there has recently come into use, for the purpose of paving, instead of asphalte, a mixture of coal-tar, and some chemicals not specified, and fine dry sand; this is stated to yield a very sound, hard, durable, and, at the same time, very cheap pavement.

December 23, 1869.

Manufacture of Sulphide of Carbon.—M. Contet.—As a proof of the greatly improved mode of manufacture of this substance and its very extensive use, the author begins by stating that, in 1840, the kilo. of rectified sulphide of carbon cost 50 francs (£2); in 1848, M. Deiss manufactured it and sold it at 8 francs per kilo., and now it may be had wholesale at 50 centimes the same quantity. The apparatus now in use consists of vertical retorts made of the same kind of clay as is in use for glass-pots; these retorts are 1·8 metre high by 0·50 internal diameter, they are lined internally with a glaze composed of 130 parts of flint glass, 20 parts of carbonate of soda, and 12 parts of boracic acid fused together, and next pulverised and painted on the inside of the retorts with gum water (at the first heating of the retorts this mixture yields a glaze which entirely closes the pores of the material, thus preventing escape of vapours and gases); four of these retorts are set in one oven made of brickwork, and are heated by a properly constructed furnace; the retorts are provided with the necessary tubes for the abduction of the vapours of the sulphide of carbon, and the introduction of the charges of sulphur and charcoal; the operation once commenced is continuous, since the retorts last for at least six months; the consumption of sulphur per retort amounts to 125 kilos. in 24 hours, introduced in charges of 155 grms. each, every three minutes time; the vapours of the sulphide of carbon are collected and condensed in vessels made of zinc or sheet-iron, and shaped like flattened down casks, and entirely covered over with cold water constantly refreshed, while the contrivance is so arranged as to keep the sulphide under water also (its specific gravity is 1·265, and its boiling point 45°). The most suitable temperature for this manufacture is bright red heat; the raw liquid obtained has to be redistilled, and this operation is conducted in large iron vessels, which contain some 5000 kilos. at the same time and communicate with six worm condensers; steam is used for heating by means of a serpentine-coiled set of pipes, and the liquid is heated to 48°; near the end of the distillation the temperature is raised to 100°, in order to drive off a raw product containing very much sulphur dissolved; in the distillatory apparatus some sulphur remains; which is removed and again applied; it appears that this industry has become very extended and is carried on with great success in France. This number contains the first portion of an interesting paper on the

Analysis of Several Different Kinds of Extracts of Meat.—M. Lebaique.—Which we shall leave for the present and abstract only when it is quite finished.

Lighting the Numbers of Street Doors at Nights.—M. Méne states that the researches of a chemist have resulted in the production of a fluid which is painted on the numbers and causes the same to shine and be perfectly visible, even in very dark nights; the process, about the nature of which nothing further is said, is stated to be simple, inexpensive, and not dangerous or injurious in any way; experiments made on the large scale have given satisfactory results.

Annalen der Physik und Chemie, von Poggendorff, No. 11, 1869.

This number contains the following original papers:—

Researches on Mica and Minerals Associated therewith.—Dr. Bauer.

Validity of the Law of Ohm for Electrolytes and a Numerical Determination of the Resistance to Conduction of Dilute Sulphuric Acid by Alternating Currents.—MM. Kohlrausch and Nippoldt.—The concluding portion of a lengthy essay.

Studies on the Oxygen Compounds of the Halogens.—M. Kaemmerer.—In the introduction to this paper, the author suggests an alteration of the nomenclature for the following compounds in the sense thereby respectively expressed, the name now in use being between brackets: —Cl, chlorine; ClH, chloric acid (chlorsäure) (hydrochloric acid); ClHO, oxychloric acid (hypochlorous acid); $ClHO_2$, dioxychloric acid (chlorous acid); $ClHO_3$, trioxychloric acid (chloric acid); $ClHO_4$, tetroxychloric acid (perchloric acid). The paper then treats of trioxybromic acid (which was prepared by the author in pure state from trioxybromate of silver) and its decomposition by means of bromine. This acid was proved to form a definite hydrate—

$$HBrO_3+7H_2O.$$

Trioxychloric acid forms a definite hydrate—$HClO_3+7H_2O$. Sp. gr. at 14°·2=1·282. When this hydrate is left standing *in vacuo* over sulphuric acid, the substance becomes more concentrated, and a momentary evolution of much gas takes place. This concentrated acid led to the formula $2HClO_3+9H_2O$. Trioxyiodic acid forms a hydrate, $2HIO_3+9H_2O$. Sp. gr. at 13°, 2·1269. Pure, solid, and crystalline anhydrous trioxyiodic acid: sp. gr. at 9°, 4·7987.

Comparative Scale for Spectra.—M. Weinhold.—The subject is entirely treated algebraically.

Experiments on Boiling.—M. Krebs.—The author investigates in this portion of his paper, and illustrates, by diagrams and descriptions of experiments, some of the less well-known and defined causes of steam-boiler explosions.

Mineralogical Communications.—M. G. Vom Rath.—This is the eighth part of a lengthy monograph, chiefly of crystallographico-mineralogical interest. Among the recent chemical analyses it contains, we quote:—*Oligoklase*, from Vesuvius. In 100 parts:—Si, 29·38; Al, 12·48: Ca, 2·06; K, 2·21; Na, 5·51; O, 47·06. *Andesin.* In 100 parts:—Na, 11·36; Al, 13·54; Si, 27·67; O, 47·43.

Lightning without Thunder.—T. Hoh.—The author states that the phenomenon seen by him at Bamberg (Bavaria) during the night of the 26th of July last was altogether distinct from the so-called *Wetterleuchten* (sheet lightning), and that, although quite close to him, he did not perceive the least sound or report, which follows sharp and well-defined lightning. There was no wind, and the night very quiet. Bamberg only contains a population of about 26,000; and, since the phenomenon was seen about midnight, there was no noise to prevent even thunder at a distance to be heard.

Journal für Praktische Chemie, No. 13, 1869.

This number opens with a brief obituary of the founder of this periodical, Otto Linné Erdmann, M.D., Ph.D., born at Dresden, April 11th, 1804, and who died on the 9th of October last. The deceased was Professor of Chemistry at

Leipzig, and founder of this periodical in 1828. His three chief co-editors (Messrs. Schweigger-Peidel, Marchand, and Werther) all died before him Dr. Erdmann's name is connected with many valuable contributions to science.

The original papers are the following:—

Derivatives of Propan (Propylhydride).—No author's name.—By means of a rather lengthy process, the author obtained a body, $C_6H_{12}O_2$; but how this substance originated could not be made out The main conclusion derived from the results of the experiments is that the general method to bring secondary alcohols to primary is as follows:—The iodine of the secondary iodides is displaced by hydrogen in the nascent state. The hydrocarbon so generated is acted upon by chlorine, whereby primary chlorides are formed. When propan is chlorinated, chloride of propylen, $CH_3-CHCl-CH_2Cl$, is formed. This, the author states, could hereby be expected, since, when ethan, C_2H_6, is chlorinated, chloride of ethylen, CH_3-CHCl_2, is formed.

Pigment Contained in Yellow Berries.—No author's name.—The colouring matter is insoluble in water. It is named rhamnegin. Formula, $C_{24}H_{32}O_{14}3H_2O$. When acted upon by sulphuric acid, it is split up into rhamnetin and sugar, rhamnetin, $C_{12}H_{10}O_5$, and $2(C_6H_{14}O_6)$. When rhamnegin is heated to 140° alone with anhydrous acetic acid, the result is the formation of a substance insoluble in water—

$$C_{24}H_{26}(C_2H_3O)O_{14};$$

while rhamnetin, treated in the same manner, yields a solid substance soluble in alcohol—$C_{12}H_8(C_2H_3O)_2O_5$.

New Volatile and Saccharine Substance from the Caoutchouc of Gaboon.—M. Girard.—The author finds, in the caoutchouc imported from the French settlement of Gaboon (West Coast of Africa), a substance which he calls *Dambonite*. It is a white-coloured, solid body. Taste sweet; very soluble in water; difficultly so in absolute alcohol; fuses at 190°; and may be sublimed at 200° to 210° without decomposition. In its crystalline state, its formula is $C_6H_8O_6$. When submitted to the action of fuming hydriodic acid, it is split up into *Dambose* and iodide of methyl; $C_6H_8O_6 + HI = C_6H_6O_6 + C_2H_3I$. Dambose is an anhydrous glucose, capable of crystallisation, insoluble in absolute alcohol.

On Rufigallic Acid.—M. Löwe.—After referring to the labours of M. Robiquet and others on this subject, the author states that, when rufigallic acid is pure, it is insoluble in water, either hot or cold, difficultly soluble in ether and alcohol, and exhibiting a red-brown powder not unlike amorphous phosphorus. Average composition in 100 parts:—C. 54·449; H, 2·697; the rest being O. Formula, $C_{20}H_6O_{12}$.

No. 14, 1869.

This number contains the following original papers:—

Contribution to the Qualitative Analysis and Detection of Dyes and Colours Imparted to Textile Fibres.—M. Stein.—This paper is to be considered as an introduction to an essay the author intends to publish on this subject, which is, indeed, a far more difficult one than is generally believed. The author gives some instances, stating that not only the material of the dye, but the duration of exposure to the dye-bath, mordants applied, the mode of cleansing (*avivage*), all concur to influence the qualitative detection of even one and the same dye material; as a general rule all dyes fixed by means of tin mordants are faster than those fixed by means of alumina mordants, and all dyes fixed without any mordant at all are more or less easily dissolved from the textile fibres. This portion of the paper treats further on blue dyes, of which, under the heading of simple (*einfach*) four kinds are enumerated, viz, (1) Indigo applied in two different ways, so-called "vat blue" and "Saxony blue;" (2) Prussian blue or cyanogen blue; (3) Blue from various dye woods; (4) Aniline blue. Mixed blue dyes.—The different qualitative tests and the mode of their application are given at full length, of which the following is a condensed abstract:—I. Heat the material to be tested with alcohol of 80 per cent and a few drops of hydrochloric acid. A. The material is reddened, and yields a red liquor. Blue from dye woods.—B. The material retains its blue colour; the fluid becomes blue coloured: (1) Aniline blue; (2) Saxony blue. C. The material remains unchanged; liquor not coloured: (1) Vat blue; (2) Cyanogen blue. II. Further treatment of the materials sub B and C. B. The fabric is tested with strong sulphuric acid; no change occurring indicates Saxony blue. When the colour changes to brownish yellow or brownish red, aniline blue is present. C. Heat with a solution of soda; no change of colour occurring indicates vat blue. When, on the other hand, this reagent causes either complete discolouration or turning to yellow or brown, cyanogen blue is indicated. It should be observed that a series of confirmatory tests are required and given at length, but space forbids to enter into further particulars.

Meteoric Iron Fallen on the Collina di Brianza (Milanese Territory).—Dr. Hausofer.—The author has made a careful analysis of a piece of this very large meteorite, about the origin of which some doubt has existed. The specific gravity of this material is 7·596; it does not contain sulphur or chromium, and was found to consist, in 100 parts—of iron, 91·1; nickel, 7·7; phosphorus, 0·3; cobalt, 0·2; and traces of carbon.

Meteorite Found near Cranbourne, Australia.—Dr. Hausofer.—Specific gravity, 3·744; contains, in 100 parts—insoluble silicates, 4·1; silica, 2·3; alumina, 1·5; lime, 1·8; phosphoric acid, 1·4; protoxide of iron, 71·1; protoxide of nickel, 3·1; water, 13·7. The hardness of this substance is about the same as that of felspar.

Action of Chloro-Chromic Acid (Chromsaure-chlorid) Upon Benzol.—Dr. Carstaujen.—The author first reviews the labours of M. Carius and others to obtain the direct oxidation of benzol, and then states that it occurred to him that chloro-chromic acid might be used for this purpose. The action of that substance upon benzol is, however, so violent that the chloride aforesaid cannot be used undiluted; as a diluent, liquid glacial acetic acid is used, and in this manner there is obtained, after proper purification, a substance, trichlorchinon, $C_6HCl_3O_2$. This material is crystalline, soluble in boiling alcohol, and its origin from benzol is explained by the following formula:—$4(CrO_2Cl_2) + C_6H_6 = C_6HCl_3O_2 + 2Cr_2O_3 + 5HCl$. When chlorochromic acid contains any free chlorine, there is also formed some tetrachlorchinon and a peculiar heavy oily substance.

Combination of Tantalum and Niobium.—M. Rammelsberg.—The author has undertaken this very laborious research in order to test the correctness of the labours of Messrs. Blomstrand and Marignac on this subject, and also to vindicate the correctness of the researches of the late M. H. Rose; the headings of the chapters of this monograph are: tantalum, atomic weight of tantalum, chloride of tantalum, bromide and iodide of tantalum, fluorides and double fluorides of tantalum, tantalic acid, salts of tantalic acid, lower oxides of tantalum, nitride of tantalum; this paper is to be continued.

On Chrysophanic Acid.—Dr. Rochleder.—After referring at some length to the labours of many chemists, as well as those made by himself on this subject some years ago, the author enters into a discussion on the statements made by MM. Graebe and Liebermann respecting the composition of chrysophanic acid, and then says, that he has taken the trouble to prepare this acid in pure state from rheine as prepared by Dr. Marquardt at Bonn; this substance consists mainly of chrysophanic acid, emodine, and impurities; the composition of pure emodine dried at 100° is, in 100 parts, C, 65·75; H, 4·29; O, 30·18; formula: $C_{40}H_{30}O_{18}$;

the formula which Messrs. Graebe and Liebermann give for chrysophanic acid, viz., $C_{14}H_8O_4$, cannot, according to the author of this paper, be the correct one, and this the less so, as no less than six different chemists have found for the formulæ of this substance, prepared from different sources and at various periods, the formula, $C_{56}H_{42}O_{17}=4(C_{14}H_{10}O_4)+H_2O$, because the H_2O of crystallisation is only driven off at 115°; it should be kept in view that emodine is very difficult to separate from chrysophanic acid, and M. Rochleder suspects that the statements of Messrs. Graebe and Liebermann about the action of pulverized zinc upon chrysophanic acid are vitiated by the presence of emodine in the acid used for these experiments.

On Toluylendiamine.—M. Koch.—This substance, a bye product of the manufacture of aniline, is readily and rather violently acted upon by anhydrous acetic acid, the result being the formation of diacetyltoluyldiamine:—

$$\underbrace{C_7H_4\begin{Bmatrix}NH_2\\NH_2\end{Bmatrix}}_{\text{toluyl-diamine.}}+\underbrace{\begin{matrix}C_2H_3O\\C_2H_3O\end{matrix}\Big\}O}_{\text{anhydrous acetic acid.}}=H_2O+\underbrace{C_7H_4\begin{Bmatrix}NHC_2H_3O\\NHC_2H_3O\end{Bmatrix}}_{\text{diacetyl-toluylendiamin.}}$$

This latter compound yields, on being heated to 150° with 1 eq. of carbonate of soda, an acetyl, and is thereby converted into monoacetyldiamine; the diacetyl compound is, by the addition of bromine, converted into monobromodiacetyltoluylendiamine,

$$\left(C_7H_5Br_7\begin{Bmatrix}NHC_2H_3O\\NHC_2H_3O\end{Bmatrix}\right)$$

a solid substance crystallising in needle-shaped crystals; when this compound is heated to 130° along with an excess of caustic potassa solution it is converted into monobromoacetyltoluylendiamine.

Les Mondes, December 23, 1869.

Estimation of the Value of Sugars for Commercial Purposes.—M. Méhay.—The author proposes that the brokers should supply standard samples of refined sugar, which should be considered as pure, for all commercial purposes, and that every assay, of any kind of sugar, whether made by means of the optical saccharimeter or by the Frommherz-Barreswil process, should be compared with an assay of the standard sample made at the same time. The samples of raw sugar marked from No. 1 to 21, adopted by the Netherlands' Society for Trade and Commerce, have been found, by repeated assays, to represent very accurately the value, and each to contain, according to the specific number, the percentage of pure sugar found therein by rigorous analytical methods; and with these samples properly marked and guaranteed genuine any analyst can be supplied by brokers. On the Continent, raw sugars are generally denominated No. so and so, by which the different qualities are readily discriminated, bought, and sold.

Falling Stars.—The Rev. Father Denza, S.J.—A very interesting and extensive account of observations made at nineteen different places in Italy, from Palermo to Moncalieri and Milano, giving for every locality the number of meteorites seen and observed at observatories during a given time.

Obituary.—The well-known scientific chemist, Stephane Robinet, who was born at Paris on the 6th of December, 1796, died at that city on the 3rd of December, last. The deceased is especially known for his zeal in analysing the natural waters of France, and for his excellent hydrographical works.

Cosmos, December 25, 1869.

Permeability of Caoutchouc Tubes.—M. Jouant.—The author states that, from a series of experiments he has made, the following conclusions may be drawn:—A vulcanised caoutchouc tube of 1·2 m m. thickness, and having a surface of 33·60 sq. m.m., loses, in three days, by diffusion, 21·3 per cent of hydrogen, while 11·2 per cent of air has at the same time entered. That the non-vulcanised caoutchouc tubing is by far less permeable for gases is proved by the following facts:—A tube of the last-named substance, having 50·00 sq. m.m. surface, has been submitted to the same experiment during twenty-eight days, and lost during that time, by diffusion, 22 6 per cent of hydrogen, while only 5·6 per cent of atmospheric air entered the apparatus, which was arranged precisely alike for both experiments, and so constructed as to indicate any change of pressure going on internally by means of manometer tubes. The permeability of caoutchouc for gases is a well-established fact, and a consequence of its peculiar structure.

Comptes Rendus des Séances de l'Académie des Sciences, December 27, 1869.

This number opens with an eulogium on—

The Annuaire du Bureau des Longitudes for 1870.—M. H. St. Claire-Deville.—The speaker observes that this very useful periodical has, in consequence of its various and comprehensive scientific data and memoranda, become indispensable to the scientific chemist; and the well-known *savant* desires to see its use greatly extended. As is known (at least to some of our readers), the periodical alluded to owes its origin to the eminent men who were foremost among the authors of the first French Republic, and who founded the Ecole Polytechnique.

Acclimatisation of the Cinchona Trees in the Island of Reunion.—M. Morin.—The author, encouraged by the success obtained in the British and Netherlands' Colonies, has induced a friend residing in the above-named island, a French possession, to try the acclimatisation of this important tree; and the result is such as to foster the reasonable expectation that the Island of Réunion will, within a few years, also become a *Cortex*-producing country.

Presence of Soda and Potassa in Divers Parts of Plants.—M. Pierre.—In reply to some objections made by M. Peligot to the author's statements on this subject, he says—I admit the presence of a small quantity of soda as a normal constituent of plants, but its quantity decreases permanently, whereas the quantity of potassa increases constantly during the life of plants. The increase of the latter base follows the same rule as the increase of phosphorus, nitrogen, &c.; and while potassa is combined in a manner which renders it a very fixed mineral, soda is easily removed by a simple treatment with distilled water.

Artificial Production of some Precious Stones.—M. Gaudin.—While presenting to the Museum of the Academy an exquisite collection of artificially-prepared precious stones, the author communicates some curious observations on the effect of a powerful oxyhydrogen blowpipe blast. Alumina, by itself, cannot serve for obtaining precious stones, owing to the tendency of this earth to devitrify again. It does not become pasty before fusing, but liquefies at once, and is as fluid as water; and next volatilises as if it were camphor. In order to render alumina viscous, quartz has to be added; but that impairs the crystallisation, and also the hardness. The colouration of the stones is another difficulty, since the enormously high temperature of the oxyhydrogen blast acts upon several substances, such as compounds of gold, silver, palladium, and other metals, in a manner quite different from that of a furnace fire. Copper is a protean substance in this aspect, and, by dexterous manipulations, may be used to produce many tints of colour. Curiously enough, manganese and nickel yield, at this high temperature, an orange-yellow colouration; and chromium, exposed to the reducing flame, gives a sky-blue, and in the oxidising flame, a deep green, which is smoked (*enfumé*), as it were, and has not even a remote resemblance to emerald green. This colour can only be obtained by a special and very well directed oxidising manipulation from oxide of copper.

Rendering Commercial Sulphide of Carbon Inodorous.—M. Cloëz.—The author states that, when sulphide of carbon is left for twenty-four hours in contact with half per cent of its weight of finely-powdered corrosive sublimate, care being taken to shake or stir up this mixture, the mercurial compound combines with the substances which are the cause of the fœtid odour of this substance, and an insoluble compound is deposited. The liquid is carefully decanted, and, after 0·02 of its weight of a pure inodorous fat has been added (no reason is given for this addition), the sulphide is redistilled with care by the heat of a water-bath. The sulphide thus obtained exhibits an ethereal odour, and is eminently suitable for the extraction of oils, fats, &c., from various substances, since, on evaporation of the purified sulphide, these matters are obtained in as fresh and pure a state as if the oils had been obtained by pressure.

Chemistry of Copper.—Dr. Sterry Hunt.—The author has instituted a comparative research on protochloride of copper, Cu_2Cl, and chloride of silver. The properties of these salts agree in so many aspects, according to the author, that he feels inclined to place these metals, copper and silver, in the same class.

General Researches on the Modifications which Minerals Undergo when Submitted to the Action of Saline Solutions.—M. Terreil.—The author describes, at great length, in this paper, the action of a solution of monosulphide of sodium (1 part of dry salt in 10 of water) upon a great number of metallic sulphides, selenides, tellurides, and antimoniosulphides; the conclusion arrived at is that monosulphide of sodium may advantageously be applied, not only for the separation, but even the quantitative determination of some metals existing in minerals in the state of sulphides.

Preparation and Properties of Hydrate of Chloral.—M. Personne.—Referring to the labours of MM. Roussin and Dumas on this subject, the author, after repeating, with great care, the experiments of the last-named eminent *savant*, concludes that the substance obtained by M. Roussin (a sample of which, given by the latter to the author, had been analysed by him) is not pure hydrate of chloral, but a trichlorinated acetate, of the formula $C_4HCl_3,C_4H_6O_2$. The author also observes that, whereas 100 parts of absolute alcohol yielded, by M. Roussin's mode of preparation, only 80 per cent of substance, he, on following exactly M. Dumas's method, obtained 185 per cent of a real and pure hydrate of choral.

Separation of Ordinary from Inverted Sugar.—M. Lubrunfaut.—The author, continuing his altercations and discussions with M. Maumené on this matter, describes in this paper, at great length, his experiments of separating, by means of lime, ordinary sugar from inverted sugar.

Simultaneous Action of the Intra-Pilair Current and Nascent Hydrogen upon Organic Acids.—M. Royer.—Under the influence of nascent hydrogen and *intra-pilair* action, the author has converted oxalic acid into formic acid.

Metamorphosis and Migrations of the Immediate Principles in Herbaceous Plants.—M. Dehérain.—This lengthy memoir contains the records of an interesting series of researches proving the curious changes which substances—as, for instance, sugar, albumen, gum, &c.—undergo in the living plants, and especially in the cereals.

Detection of Cyanhydric Acid and Cyanides in Cases of Poisoning.—M. Bonjean.—A foot note added to this title of a paper, and signed "D.," informs the reader that this paper could not be printed for want of sufficient experimental details.

Heavy Flint-Glass for Optical Purposes.—M. Feil.—This gentleman sends in samples of perfectly homogeneous glass free from any bubbles or defects, and in masses weighing from 25 to 35 kilos. The process whereby this is obtained is not explained; but the statement is made that the crucibles having been protected from the effects of the lead, a heavier glass even than Faraday's can be made. The maker sends, also, a set of samples of beautifully-made artificial precious stones, not mere specks, but of good size. The mode of manufacture applied to these gems will, according to the author's statement, give interesting results for the study of some optical phenomena. The aluminates of lime, of baryta and lime, of lead and of bismuth, are proposed for flint-glass; and the aluminates of magnesia and the silicates of magnesia and alumina for crown-glass.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 18, 1869.

At the ordinary meeting of this Society, held on the 22nd of November last, under the presidency of Dr. A. W. Hofmann, the following papers were read:—

Lecture Experiment to Show the Increase of Weight Caused by Combustion.—Dr. Kolbe.—Since the value of this paper rests entirely upon the woodcut annexed to it, describing the very ingenious apparatus contrived by the author, we only mention the title.

Carbonate of Phenol.—M. Kempf.—When three parts of phenol and two of fluid phosgen are heated to about 150°, and the contents of the tube afterwards treated with a dilute solution of caustic soda, a solid substance is obtained which crystallises from its alcoholic solution in white silky-looking needle-shaped crystals. The formula of this substance is $C_{13}H_{10}O_3$; it is insoluble in water, readily soluble in alcohol and ether, fuses at 78°, and can be sublimed. When treated with concentrated caustic soda solution, it yields carbonate of soda and phenyloxyd-soda; its formula, as carbonate of phenol, is $(C_6H_5)_2O_2(CO)$.

Action of Chloro-Chromic Acid (Chromsaure-chlorid) upon the Aromatic Hydrocarbons.—M. Carstenjen.—Chloro-chromic acid, CrO_2Cl_2, acts, when pure, with so great violence upon most organic substances, that deflagration ensues. The author has found that glacial acetic acid is the best diluent, and with such a solution he has investigated its action upon the following substances:—*Benzol.** *Naphthalin* yields a compound, $C_{10}H_4Cl_2O_2$, fusing at 188°, and soluble only in boiling alcohol; it is a bichloronaphthochinon, and is derived from naphthalin according to the following formula:—

$$4CrO_2Cl_2+C_{10}H_8=C_{10}H_4Cl_2O_2+2Cr_2O_3+4HCl+2Cl.$$

Anthracen yields bichloronaphtochinon and anthrachinon, free from chlorine; formula, $C_{14}H_8O_2$. *Toluol* yields benzoic acid and rather complex results, which are formulated thus:—

$$C_6H_5.CH_3+2CrO_2Cl_2=C_6H_5.COCl+3HCl+Cr_2O_3.$$

The $C_6H_5.COCl$ acts further upon the glacial acetic acid, in the following manner:—

$$C_6H_5.COCl+CH_3.COOH=\left\{\begin{matrix}C_6H_5.CO\\CH_3.CO\end{matrix}\right\}O+HCl,$$

and the mixture of *anhydrous acids* yields, with H_2O, benzoic acid and acetic acid. With xylol, the final result of the reaction is an acid—a solid substance fusing at 173°, and of the composition of toluylic acid—and besides, also, terephthalic acid. Pure mesitylen prepared from aceton is almost insoluble in glacial acetic acid; the action of chloro-chromic acid is consequently very violent, and great caution is required in managing this experiment. The result is the formation of mesitylenic acid.

Contribution to the History of the Sulphocyanides of the Alcohol Radicals.—M. Henry.—This paper is divided into the following sections:—Action of iodide of cyanogen upon mercuro-mercaptan, $(C_2H_5)2HgS_2$; trisulphocyanallyl, $C_3H_5(CNS)_3$; sulpho-cyanide of benzyl, or methyl-benzol, $C_6H_5—CH_2CNS$; nitro-sulphocyanide of benzyl, $C_7H_6(NO_2)CNS$.

* The author's paper on this subject, in the *Journal fur Praktische Chemie*, No. 14, 1869, having been abstracted by us, we pass this portion over in silence.

Direct Combination of Chloride of Phosphorus (PCl_3) with Sulphur.—M. Henry.—The author says:—Dr. Odling states, in his excellent "Manual of Chemistry" (vol. i., p. 287), that oxygen and chloride of phosphorus combine directly at the boiling-point of the chloride. Acting upon this hint, the author tried whether sulphur would act in the same manner, and yield $PSCl_3$. Very pure chloride of phosphorus, boiling to 78°, was heated to 130°, along with pulverised sulphur, in a sealed tube; the sulphur disappeared. On being submitted to distillation, the fluid came all over at 120°, and the distillate, a colourless fluid exhibiting a sharp smell, proved to be the compound $PSCl_3$.

Wax of Corn-Straw.—M. Radziszewski.—After referring to the researches on the subject of the wax of the *Gramineæ*, made by Dr. G. J. Mulder, M. Dumas, and others, the author states that he has found a waxy substance in the straw of the corn species. This substance is insoluble in water and solutions of caustic alkalies; soluble in boiling alcohol, ether, and sulphide of carbon; fuses at 42°; boils, without decomposition, at 300°; and sublimes at 303°. This substance has, therefore, some analogy with the *cérosie* from sugar-cane. The author states that the sample investigated by him was given him by M. Naeyer, paper manufacturer at Willebroeck lez Malines, Belgium, who appears to have first obtained this material while converting straw into pulp.

On Mercurodiphenyl.—M. Otto.—The author refers back to a paper on this subject by him and M. Dreher (see Chemical News, vol. xx, p. 285; *Am. Repr. Feb.* '70, *page* 103), and explains, in this present paper, his views, dissenting from some statements made by his co-partner. The paper is not suited for abstraction.

Hydrate of Bromal, and its Action upon the Animal Organism.—M. Steinauer.—The author prepares the hydrate of bromal by causing a current of carbonic acid, saturated with vapours of bromine, to pass into alcohol. The hydrate of bromal thus obtained in large crystals was purified by re-crystallisation, and then used for experimenting with upon animals.

Action of Iodide on Thiobenzamide.—Dr. Hofmann.—When, to a cold saturated alcoholic solution of this benzamide—

$$\left.\begin{matrix} C_7H_5S \\ H \\ H \end{matrix}\right\} N,$$

an alcoholic solution of iodine is added, the latter soon becomes decoloured, and sulphur is precipitated; when iodine is added in slight excess, the liquid, after having been decanted from the free sulphur it contains suspended, becomes a thick magma on the addition of water. By washing with the latter, the hydriodic acid is removed; and by re-solution and repeated re-crystallisation from boiling alcohol, a solid snow-white substance is obtained, fusing at 90°, and subliming, without decomposition, at a high temperature; this substance is also soluble in ether, chloroform, and benzol, and the author considered he had to deal with a compound freed from sulphur, since even delicate tests failed to indicate its presence. When, however, the vapour of this substance is passed over a red-hot mixture of pure nitrate of potassa and carbonate of soda the presence of sulphur is ascertained without difficulty. Elementary organic analysis of this substance led to the formula $C_{14}H_{10}N_2S$, and its formation is expressed by the following equation:—

$$2C_7H_7NS+2II=C_{14}H_{10}N_2S+4HI+S.$$

Chlorine, bromine, and moderately-dilute nitric acid act in the same manner upon thiobenzamide. The author states that the new compound just alluded to exhibits a most remarkable stability, and a stolid insensibility against the action of even rather strong reagents and rough treatment. Acids, even at boiling-point and in sealed tubes, do not affect this material, and the action of alkalies is very gradual and slow; by hydrogen, *in statu nascendi*, it is converted into a base, the hydrochlorate of which is formulated by $C_{14}H_{14}N_2,HCl$; and the composition of the platinum salt is $2(C_{14}H_{14}N_2,HCl)PtCl_4$.

Under the title of "Correspondence," this number contains:—

Review of the Labours of the Chemistry Section of the Late Meeting of German Physicists and Natural Philosophers at Insprueck.—Dr. Gunning read an interesting paper on the use of perchloride of iron for the purification of potable waters.—Prof. Barth spoke on the isomeric modifications of toluolsulpho acid and its decomposition by fusing caustic potassa. The chief point of interest, as regards this matter, is that the author has succeeded in obtaining, from crude toluolsulpho acid, certainly two, and probably three, quite distinct modifications, as exhibited by the difference of the potassa salts of the same.—Prof. Kekulé spoke on the constitution of salts.—Dr. Marquart called attention to the action of perfectly neutral solutions of nitrate of strontia upon wrought-iron vessels used to evaporate that liquid, the consequence of which is the cracking and tearing-up of the metal.—Dr. Batka read a paper on tea, and called attention to the great discrepancies of the analysis of that substance. In the discussion which followed, Prof. Hlasiwetz observed that the quantities of the general principles of plants vary to such an extent, and are so dependent upon the conditions under which plants are grown, that the quantitative estimations thereof are of very little value.

The St. Petersburg correspondent writes—"At the meeting of the Chemical Society held on the 6th of November, O. S. (1869), M. Morkownikoff stated—When any alcohol gives off the elements of water, or when its haloid anhydride gives off a haloid hydrogen, there is simultaneously given off one atom of hydrogen, which is combined with an atom of carbon. By direct addition to unsymmetrically-constituted hydrocarbons, CnH_{2n}, of the elements of H_2O and HX, the latter are so divided that the hydroxyl or haloid combines with that atom of carbon with which the smallest number of hydrogen atoms are combined. According to this view, normal butyl-alcohol ought to yield a butylen, $CH_3-CH_2-CH=CH_2$, and with HI, the iodanhydride of the secondary pseudo-butylalcohol of Luynes; and the isobutylalcohol must yield the tertiary butylalcohol of Butlerow—

$$CH\left\{\begin{matrix} CH_3 \\ CH_2.OH \end{matrix}\right. \quad \text{should give} \quad C\left\{\begin{matrix} CH_3 \\ CH_3 \\ \| \\ CH_2 \end{matrix}\right. \quad \text{and} \quad CI\left\{\begin{matrix} CH_3 \\ CH_3 \\ CH_3 \end{matrix}\right.$$

The experimental researches on this subject, instituted with the isobutylalcohol of fermentation, fully proved the correctness of these views, which are confirmed by M. Butlerow, who has been experimenting in the same direction. M. Gustavson stated that, while heating boracic acid with pentachloride of phosphorus in sealed tubes to 140°, chloride of boron, $BoCl_3$, is readily obtained. Upon causing nitric acid to act upon acetoluide, MM. Beilstein and Kuhlberg have obtained mono- and dinitro-acettoluide. The former yields, with caustic potassa, orthonitrotoluidine; this substance differs from the paranitrotoluidine (as obtained from dinitrotoluol) by its fusing-point, 114°, and by not being capable of combining with acids. M. Wroblewsky has prepared, from chlorotoluol boiling at 156°—160°, a nitrochlorotoluol boiling at between 242° and 255°; by repeated fractional distillation, he obtained two isomeric substances—*a*, boiling at 243°, sp. gr. 1·307 at 18°; and *β*, boiling-point 253°, sp. gr. 1·3259 at 18°.—MM. Engelhardt and Latschinow communicated researches made by them on toluolsulpho potassa and the potassium-salts of xylolsulpho acid.—M. Maikopara communicated his researches on *a* and *β* naphthalin-sulpho acids and the chloranhydride, amide, and mercaptan of that series.—M. Mendelejeff read a

lengthy paper on specific heat, and his researches on this subject.—This ends the correspondence.

Researches on the Ethereal Derivatives of the Polyvalent (Mehrwerthigen) Acids and Alcohols.—M. Henry.—This lengthy paper, a continuation of a former on the same subject, contains the following sections:—Aniso-derivatives; anisaldehyde; aniso-nitril, or methyl-paroxybenzoyl-nitril—

$$C_6H_4 \begin{cases} CH_3O \\ CN \end{cases}$$

nitro-aniso-nitrile—

$$C_6H_3(NO_2) \begin{cases} CH_3O \\ CN \end{cases}$$

New Series of Double Chlorides belonging to the Platinum Bases.—M. Thomsen.—This paper is too much filled with formulæ to be fit for any useful abstraction.

Synthesis of Hydroxylamine.—MM. Ludwig and Hein.

Strychnine an Antidote against Poisoning with Chloral.—M. Liebreich.

Critical Remarks upon M. Otto's Paper on Mercurodiphenyl.—M. Dreher.

Zeitschrift für Chemie von Beilstein, No. 23, 1869.

This number contains the following original papers:—

Derivatives of Naphthalin.—MM. Faust and Saame.—The authors have prepared and fully investigated the chlorinated substitution products of naphthalin. They describe A, what they call addition products, viz.:—Naphthalintetrachloride, $C_{10}H_8,Cl_4$, a solid substance fusing at 182°, and crystallising from its chloroformic solution in large rhombohedric crystals; monochloronaphthalintetrachloride, $C_{10}H_7Cl,Cl_4$, also a solid substance crystallising in klinorhombic prisms, and fusing at about 129°; dichloronaphthalintetrachloride, $C_{10}H_6Cl_2,Cl_4$, again a solid substance, crystallising in klinorhombic prisms, and fusing at 172°. All these substances are devoid of smell, difficultly soluble in alcohol, more readily soluble in ether and ligroine; their best solvent is chloroform. B, substitution products:—Monochloronaphthalin, $C_{10}H_7Cl$, a colourless oily fluid, boiling at 250°; monochlorodinitronaphthalin, $C_{10}H_5Cl(NO_2)_2$, a yellow-coloured solid, crystallising in needle-shaped crystals, and fusing at about 104°; *a* dichloronaphthalin, $C_{10}H_6Cl_2$, a fluid, boiling at about 280°; *a* tetrachlorotribromodinaphthalin, $C_{20}H_9Cl_4Br_3$, a solid substance, crystallising in white needle-shaped crystals, and fusing at 74°; *β* dichloronaphthalin, $C_{10}H_6Cl_2$, exhibiting prismatically-shaped crystals, soluble in ether, and fusing at about 282°; *β* tetrachlorotribromodinaphthalin, $C_{20}H_9Cl_4Br_3$, a solid, fusing at 72°; trichloronaphthalin, $C_{10}H_5Cl_3$; heptachlorodinaphthalin, $C_{20}H_9Cl_7$; heptachlorodinitrodinaphthalin, $C_{20}H_7Cl_7(NO_2)_2$; *a* tetrachloronaphthalin, $C_{10}H_4Cl_4$; *β* tetrachloronaphthalin, $C_{10}H_4Cl_4$. All these substances are readily soluble in ether, ligroine, and chloroform, but difficultly so in alcohol; they exhibit the smell of naphthalin. The nitro-products are chiefly yellow-coloured soft substances, difficultly obtainable in pure state.

Some Derivatives of *a* and *β* Naphthalin Sulpho-Acids.—M. Maikopar.—The substances submitted to investigation by the author are:—The chloranhydride of the *a* naphthalin sulpho-acid, *a* $C_{10}H_7SO_2Cl$, a solid substance, exhibiting foliated crystals; readily soluble in ether, sulphide of carbon, and benzol; fuses at 66°. *a* amide, *a* $C_{10}H_7SO_2.NH_2$, also a solid substance, readily soluble in water and alcohol, and fusing at 150°. *a* mercaptan, *a* $C_{10}H_8S$, an oily fluid, insoluble in water, but soluble in alcohol and ether; its alcoholic solution yields, with an alcoholic solution of acetate of lead, a yellow-coloured precipitate, a lead compound, $C_{10}H_7PbS$. Chloranhydride of *β* naphthalin sulpho-acid, *β* $C_{10}H_7SO_2Cl$, a solid substance, insoluble in water, more difficultly soluble in ether than the *a* compound, crystallises in foliated crystals, and fuses at 76°. *β* amide, *β* $C_{10}H_7SO_2.NH_2$, difficultly soluble in water and ether, and soluble in boiling alcohol. *β* mercaptan, *β* $C_{10}H_8S$, insoluble in water, soluble in alcohol and ether, crystalline, and fuses at 136°.

Preparation of Kresotinic Acid from Xylol.—MM. Engelhardt and Latschinoff.—1000 grms. of xylol from coal-tar oil were combined with sulphuric acid; a potassa salt of the sulpho-acid was made, properly purified by recrystallisation, fused with caustic potassa; the fused mass first treated with water, next with hydrochloric acid, and then treated with ether; the ethereal extract treated with a solution of caustic soda. On evaporating the ether, after decantation, a mixture of xylenols was obtained. The aqueous soda solution yielded, after evaporation and saturation with hydrochloric acid, a substance which on investigation was found to be *a* kresotinic acid.

Combination of Sulphuric Acid with the Oxides of Nitrogen.—Dr. Winkler.—The author's researches gave the following results:—(1) Hydrated sulphuric acid does not absorb deutoxide of nitrogen. (2) Hydrated sulphuric acid combines readily, and with evolution of much heat, with nitrous acid; this combination is very strong and intimate, is not destroyed by heating, but immediately so by addition of water; the chamber crystals (viz., those sometimes met with in the leaden chambers of sulphuric acid works) consist of this compound. (3) Deutoxide of nitrogen and oxygen do not, when sulphuric acid is simultaneously present, combine to form, as usual, hyponitric acid, but form nitrous acid, even when oxygen is in excess. (4) Hyponitric acid combines, in gaseous, as well as in fluid state, with hydrated sulphuric acid; but this combination, supposing it to deserve that name in a chemical sense, is very loose and unstable; heat destroys this compound, hyponitric acid is given off, either unchanged, or it is converted into nitrous acid, which combines with the sulphuric acid, and free oxygen is given off. The mode of this decomposition depends entirely upon the strength of the sulphuric acid under investigation. (5) Sulphuric and nitric acids only form mechanical mixtures together. (6) Nitrous and sulphurous acids yield, when moisture is present (steam in the chambers), hydrated sulphuric acid and deutoxide of nitrogen, which escapes. (7) Hyponitric acid forms, when in contact with moist sulphurous acid, nitrososulphuric acid, exhibiting solid crystalline structure. These researches have been made with the view of illustrating the action of the Gay-Lussac condensers of sulphuric acid works.

Alleged Presence of Dextrine in the Chesnut.—M. Ludwig.—The author has instituted some experiments in order to test the correctness of M. Albini's statement that the well-known eatable chestnuts (*marrons*) should contain from 22·8 to 23·3 per cent of dextrine. The result of the author's experiments is that this fruit does not contain any dextrine at all, which result agrees with those obtained by several other analysts of this fruit.

New Work on the History of Chemistry.—Dr. A. Ladenburg.—Under the title "Vorträge über die Entwicklungsgeschichte der Chemie inden letzten Hundert Jahren" ("Lectures on the History of the Development of Chemistry during the last Hundred Years"), the author has, according to the editor of this periodical, edited a most excellent complementary volume to Kopp's well-known "Geschichte der Chemie." The work alluded to is in the shape of fourteen lectures on the subject; the arrangement is strictly chronological, and, beginning from Lavoisier, contains a complete, yet concise, record of the history of theoretical chemistry up to the present day. This work is highly eulogised by Dr. Fittig, who wrote a review of it for the above-named periodical.

Les Mondes, December 30, 1869.

Letters on Geology.—M. L'Abbé Choyer.—Although not exactly belonging to the subjects generally treated of in our publication, we call attention to these letters, which are written with great skill, and contain, condensed, a large amount of very useful and interesting information.

Cosmos, January 1, 1870.

Displacement of the Bed of the River Rhine.—M. Bouslot.—The course of the Upper Rhine has very greatly altered, its movement being from west to east (a lateral movement to the course of the downward current) between the Alsatian and Baden banks.

Bread and Railway-Sleepers.—By an order recently issued by M. le Maire de Douai, the bakers of that town have been prohibited from using the wood of old railway sleepers as fuel for their ovens, since many of these sleepers have been impregnated with sulphate of copper, and there is danger that some compound of copper might poison the bread. To the Maire, as head of the local police, is entrusted the proper supervision of everything which may injuriously affect the health of the population.

Journal für Praktische Chemie, No. 15. 1869.

This number contains the following original papers:—

Some of the Substances met with in the Leaves and Bark of the Cerasus Acida.—Dr. Rochleder.—In a lengthy memoir, we find the enumeration of a lengthy series of substances partly met with in the leaves, and more especially in the bark, of the tree alluded to. The leaves contain amygdaline, some citric acid, quercitine, and a substance, $C_{21}H_{20}O_9$; the bark contains—phlobaphen, fuscophlobaphen, æscylic acid; rubrophlobaphen, a peculiar tannin, isophloroglucine, and isocaffeic acid.

Cane Sugar in Madder-Root.—M. Stein.—The author states that the existence of cane sugar in madder-root has not been hitherto proved. This statement is, however, erroneous, since even about the latter end of the last century attention has been directed to the fact that madder-root, and especially the Zealand madder, is rich in cane sugar, containing between 14 and 16 per cent. The extraction of this sugar, without interfering with the tinctorial value of madder, and by means different from those whereby that sugar is now utilised—viz., fermentation, and making of alcohol—is not elucidated, only discussed, in this paper. Since some 10,000,000 kilos. of madder are, at the very lowest estimate, consumed annually, and since the bulk of the sugar therein contained is utterly lost, there is a fair field of profitable experimental research still left open and untouched.

Fermentation Induced by the Microzyma of the Liver.—M. Kolbe.—320 c.c. of absolute alcohol, 40 grms. of freshly-cut-up sheep's liver, and 16 litres of water, were left standing for five months. The fluid was found to exhibit a very acid reaction, and to give off the odour of sweat. After filtration, the fluid was submitted to distillation, the retort being placed in a chloride of calcium bath, the distillate neutralised with soda, and the alcohol, which had come over unchanged, removed by distillation; the residue, treated with sulphuric acid, yielded capronic and other fatty acids.

No. 16, 1869.

None of the papers of this number are original, and the contents have been abstracted by us already. The death of the chief editor has caused this deviation from the rule; but the publisher states that satisfactory arrangements are being made to obtain original communications.

Zeitschrift für Chemie von Beilstein, No. 1, 1870.

This number contains the following original papers:—

Behaviour of the Flesh-Coloured Sulphide of Manganese with Various Reagents and at Variable Conditions of Temperature and Pressure.—M. Muck.—The sulphide of manganese alluded to was submitted, in sealed tubes at from 140° to 150°, to the action of water, sulphuretted hydrogen, hydrosulphuret of ammonium, polysulphide of potassium, ammonia, and caustic potassa solution. No very perceptible reaction was seen with water, sulphuretted hydrogen, and ammonia; with sulphide of potassium, the bulk of the manganese sulphide was left unaltered, but a small portion of the tube was coated with a very firmly-adhering violet precipitate; hydrosulphuret of ammonium caused complete conversion into green sulphide; with caustic potassa, the sulphide of manganese was converted into greyish white hydrated protoxide of the metal.

Action of Hydrochloric Acid upon Nitrobenzol.—Dr. Baumhauer.—When concentrated hydrochloric acid and nitrobenzol are heated in sealed tubes to 245° (the tubes often explode), there is found in the tube, after cooling, a crystalline substance, which, on being treated with boiling water, yields hydrochlorate of dichloraniline, some hydrochlorate of aniline, an oily substance difficult to purify, and a solid crystalline matter the nature of which could not be further determined; so that, *summa summarum*, this reaction is, in the main features, similar to the action, under the same conditions, of hydriodic and hydrobromic acids, with this difference—that the temperatures for the two last-named are, respectively, 104° and 185°.

Contributions from the Chemical Laboratory at Griefswald.—M. Otto.—A series of papers with the following headings:—On mercuro-diphenyl (a monograph on this subject). Mercuro-ditolyl—

$$C_6H_4 < \begin{matrix} CH_3 \\ Hg \end{matrix}$$
$$C_6H_4 < \begin{matrix} \\ CH_3 \end{matrix}$$

a solid substance, insoluble in water, difficultly soluble in alcohol, and rather more soluble in hot benzol, chloroform, and sulphide of carbon; it fuses at 235°. Mercuro-monotolyliodide, a solid substance, insoluble in water, difficultly soluble in alcohol, and fusing at 220°. Aceto-mercuro-monotolyl—

$$C_6H_4 < \begin{matrix} CH_3 \\ Hg \end{matrix}$$
$$C_2H_3O—O$$

a solid, crystallising in rhombic prisms, fusing at 153°, somewhat soluble in boiling water, but better soluble in alcohol and benzol. Behaviour of dibenzyl at a higher temperature (chiefly a series of formulæ). Conversion of this phenol (phenylsulpholydrate) into phenylsulphide. Mercuro-dinaphthyle. Aceto-mercuro-monomethyl and aceto-mercuro-monoethyl. Preparation of organic sulphur compounds by means of hyposulphite of soda.

Non-Volatile Acids, of Croton Oil, and the Non-Existence among them of an Acid $C_5H_6O_2$.—M. Geuther.—A review of the author's labours as compared with those of others on this subject.

Conversion of Isobutyl-Alcohol into Tertiary Pseudobutyl-Alcohol.—Dr. Markownikoff.—The reactions are represented in the following manner:—

$$\begin{matrix} CH_2I \\ CH \\ CH_3CH_3 \end{matrix} - HI = \begin{matrix} CH_2 \\ \| \\ C \\ CH_3CH_3 \end{matrix}$$

Isobutyl-alcohol — Isobutylen.

$$\begin{matrix} CH_2 \\ \| \\ C \\ CH_3CH_3 \end{matrix} + HI = \begin{matrix} CH_3 \\ Cl \\ CH_3CH_3 \end{matrix}$$

Tertiary Butyl-iodide.

Azoxytoluide.—M. Petrieff.—After briefly stating that M. Jaworski calls azoxytoluide an oil-like substance, the author says—The substance prepared by me from azotoluide by the action of sodium-amalgam is a solid crystalline substance, fusing at 57°, and soluble in ether and alcohol. On being treated with sodium-amalgam, it yields hydrazotoluide.

Preparation of Aniline-Red without Arsenic.—M. Coupier.—The author has succeeded in obtaining fuchsine by the action of hydrochloric acid and iron, in small

quantities, upon pure aniline and nitrotoluol, taking care to apply a suitable temperature. Commercial aniline and commercial nitrobenzol also yield the same result; and M. Schützenberger states that, having been requested to test the results of this reaction, he has found that the aniline-red obtained is identical with that ordinarily made, and declared it to be a salt of rosaniline. The yield is very fair, and somewhat larger than when arsenic is used.

Cosmos, January 8, 1870.

Platinum Light.—M. Schinz.—According to the author's experiments, platinum, made incandescent, and brought to bright white heat by means of the ignition of a mixture of hydrogen and carbonic oxide gases, yields a light which, in relation to good coal-gas, is as 1·24 to 1 0.

Origin of the Fatty Oil contained in Olives.—M Harz.—According to the author's experiments, the results obtained in this investigation are:—The substances secreted in the fruit do not, at its first formation, contain any fatty oil. Up to the time of ripening there exist in the fruit, in the state of membranes, undeveloped cells, which become the seat of secretion of the oil, and which membranes may be rendered visible by means of reagents; each of these rudimentary cells contains a very large number of extremely small cells, which, at the time of ripening of the fruit, are converted into fatty oil. The membrane just alluded to may be rendered visible by the successive application of a solution of aniline and chloroiodide of zinc, whereby the membrane of the cells which contain a fatty oil assume a beautiful blue colour.

Discovery of Coals in Algeria and Turkey.—According to a statement in the *Echo d'Oran*, it appears that there has been found, near Laghouat, an excellent and abundant seam of coal, near the spot where the ancient Romans worked manganese, iron, and zinc mines. As regards the last-named country, M. Hochstetter states that he has found coal near Kézoulik, under the carboniferous limestone on the southern slope of the Balkan mountains.

Observatory on Mount Ararat.—The Russian Government have resolved to establish an astronomical and meteorological observatory on this mountain, situated near Tiflis, in consequence of the excellent report given by M. Piazzi Smyth of the fitness of such high situations, deduced from his experience on the Pic de Teneriffe.

Discovery of an Ancient Silver Mine.—The recent earthquakes in Germany have caused the fall of a large mass of rocks situated between Heidelberg and Weisloch and in consequence thereof the works of a silver mine, worked by the ancient Romans, have been brought to light. There is no silver-ore of any importance left, but, instead, a very rich zinc ore is met with in large quantity, which was left untouched by the former workers.

Polytechnisches Journal von Dingler, first number for November, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

Dioptrical Notices.—Dr. Pohl.

Estimation of Sulphur and Gypsum in Animal Charcoal.—M. Reichardt.—The main feature explained in this paper is, that animal charcoal may, and often does, contain considerable quantities of gypsum; but, besides this, sulphur, apparently in combination with carbon, in a similar manner as sulphur may be met with in coke. The estimation of the sulphate of lime is effected, either by boiling the material under investigation with pure hydrochloric acid, or repeatedly with a solution of pure carbonate of soda. The sulphur is estimated by fusion and ignition of the animal charcoal with pure nitrate of potassa, and in each case the sulphuric acid is estimated in the usual way.

On Jute. -Dr. Wiesner.

Second number for November, 1869.

This number contains the following original papers relating to chemistry or allied sciences:—

On the Various Means of Saving Fuel in the Metallurgical and Technical Applications thereof.—M. Schinz.—The author discusses, in this memoir, the subject under the following heads:—Increase of the size of the furnaces; decrease of the conductibility of the same; complete combustion; previous heating of air, as well as of fuel; preparation of combustible gases without nitrogen being among the same; highest possible consumption of fuel in a given time; combustion, under increased pressure, of air.

Newest Shape of M. Wild's Polaristrobometer (Saccharimeter, Diabetometer).—M. Wild.—Description of a very ingeniously-contrived apparatus, illustrated by a series of engravings.

Gas for Heating Purposes.—Dr. Ziurek.—The author states that gas from the brown coal from Furstenwald, five miles from Berlin, will be made on the spot, and collected in Berlin in twelve gas-holders, each of a capacity of 750,000 cubic feet. The gas will be carried, as usual, in underground mains, and mainly applied for heating purposes. 100 parts of the gas (sp. gr., 0·5451) consist of:—Hydrogen, 42·36; oxide of carbon, 40·00; marsh gas, 11·37; nitrogen, 3·17; carbonic acid, 2·01; condensible hydrocarbons, 1·09. 3000 cubic feet of this gas have a heating power of one-third of a ton of best coals, and are equal to 1 ton of best Prussian brown coal. 1000 cubic feet of this gas will cost about 5d. in Berlin; and the equivalent value of the heating power of this gas, as compared with a ton of coals, will be 4s. 6d. The works have been made to supply 9,500,000,000 cubic feet of gas annually, or at the rate of 2⅔ millions of cubic feet daily.

Thymol, a New Disinfectant.—M. Paquet.—The author proposes the use of thymol, so-called thymianic acid, the stearopten of the essential oil from *Ptychotis ajowan*, an umbelliferous plant growing in India. In undiluted state, this substance is a caustic, and used in dentistry for the cauterisation of hollow teeth; its advantage in this aspect being that it has not an unpleasant taste, and, being very aromatic, does not affect the breath as carbolic acid does. Its aqueous solution is a strong antiseptic, and possesses disinfectant properties in a very high degree.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 203, 1869.

This number contains the following original papers and communications relating to chemistry:—

Injurious Effects of Impure Alcohol upon Aniline Colours.—Dr. Tillmanns.—The author has examined several varieties of alcohol, and tested the effects upon aniline colours. The most sensitive among these, for impure alcohol, is aniline purple (phenyl-rosaniline). It appears that empyreumatic substances, aldehyde, the peculiar fusel oils due to the substances used in the manufacture of the alcohol—viz., grain (malted or raw), potatoes, the refuse of beet-root sugar manufacture—affect the aniline colours when dissolved in such alcohols and boiled therewith. The best test for the purity of an alcohol is to dissolve in it 1 per cent of perfectly pure caustic potassa, and to heat the solution; it should only acquire a bright yellow colour. Another test is to dissolve 1 part of the aniline purple alluded to in 50 parts of the alcohol to be tested, and to heat the fluid for some time. If, after half-an-hour's heating, no change is observed, the quality of the alcohol is good; but if the latter is not pure enough, the mixture soon becomes turbid, and assumes a red colour. Aldehyde is often present in alcohol, especially if it has been purified by means of charcoal.

Moniteur Scientifique, No. 313, January 1, 1870.

This number opens with a full and lengthy account of the

proceedings taken by the Ministère Public of the Tribunal Correctionel de Paris *in re* the explosion of the 16th of June last on the Place de la Sorbonne, caused by picrate of potassa. From the scientific, as well as other evidence given about the danger of picrate of potassa (several artillery officers and the Director of the Pyrotechnic School at Toulon having been examined), it appears that the substance alluded to is, as might be expected, far less to be feared than gunpowder, gun-cotton, and salts of fulminic acid. The accused, M. Fontaine, was fully acquitted, in every respect, of the charges made against him of having caused manslaughter by imprudence.

Artificial Porphyry.—MM. Sepulchre and Ohresser.—It appears that the authors have perfectly succeeded in utilising the slag of the iron blast furnaces for the manufacture of paving-stones, which withstand a crushing weight of more than 400 kilos. per square centim., and have answered for the purpose of paving several streets at Brussels and Paris, and stood heavy traffic far better than even the celebrated Quenast stones. The streets paved with this material at Brussels have a heavy gradient.

Lignite from Vescovado, Province of Sienna, Italy.—M. Kopp.—At only eight metres under the surface of the soil, is found a layer of lignite of 3·5 metres thickness. This substance, having been submitted to analysis, yielded, on being dried at 115°, 21·80 per cent of water. On being calcined in a closed crucible, 100 parts gave:—Volatile combustible matter, 26·48; fixed carbon, 42·52; ash, 9·20; water, 21·80. When submitted to dry distillation in a gas retort, acetic acid is among the products, and 51 per cent of coke; the quantity of sulphur amounts to 1·36 per cent. 1 kilo. of lignite is capable, on combustion, of evaporating 6·1 litres of water. Since there is no coal found in any part of Italy, as far, at least, as it has been explored, this material is of considerable value to the industry of that country.

Artificial Alizarine.—MM. Meister and Lucius.—These gentlemen write to the editor of the above-named periodical in reference to what was stated about their invention, and abstracted by us (see Chemical News, vol. xx., p. 299; *Am. Repr. Feb.* '70, *paje* 108), and, denying the truth and correctness of what is there given, now explain that they legally deposited the secret of their mode of manufacture with the Burgomaster of Hoechst (Prussia), and that, consequently, legal proof can be given both as to their peculiar process and as regards priority. They also state that the first samples made were not quite satisfactory, but that now they are in full swing, and have such an increased demand for their produce as to render it impossible for them to serve their customers immediately, they having to wait till their turn comes.

Detection of Fixed Fatty Oils obtained from the Seeds of Cruciferæ.—M. Gréhaut.—Some fatty oils, especially those obtained from the *Cruciferæ* (colza, rape, cameline, mustard), naturally contain sulphur. This may serve for the detection of these oils by boiling some 25 grms. of the same with an aqueous solution of 2 grms. of caustic potassa in 20 grms. of water. When the mixture is poured on to a previously-moistened filter, the filtrate will blacken paper soaked in acetate of lead or nitrate of silver; and, on addition of some hydrochloric or sulphuric acids, sulphuretted hydrogen is given off, easily recognised by the smell. Linseed, nut, sesame, or ground-nut oils, do not contain sulphur, and do not, consequently, give rise to this phenomenon, if treated in the same manner. The experiment is best performed in a clean bright silver capsule, which, of course, becomes at once brown- or black-coloured, owing to the formation of sulphide of silver in a more or less degree.

Revue Hebdomadaire de Chimie, January 6, 1870.

Manufacture of Soda by the Use of Strontia and Ammonia.—M. Ungerer.—When, to a concentrated solution of sulphate of ammonia, is added an equivalent quantity of chloride of sodium, and the fluid heated to boiling-point, mutual decomposition of these salts takes place, and sulphate of soda and chloride of ammonium is formed; the former salt separates as a crystalline powder, and may be removed by filtration from the solution of the chloride of ammonium. The sulphate of soda, having been dissolved in water, may be decomposed by caustic strontia, thus yielding caustic soda; the chloride of ammonium may be converted into carbonate of ammonia by means of chalk. It is doubtful whether this process, theoretically correct, will be commercially available.

Bleaching of Fixed Fatty Oils.—M. Diéterich.—Into a wooden tub, provided with a properly-constructed tap at the bottom, are poured 30 litres of water, wherein 1 kilo. of permanganate of potassa is dissolved. To this mixture is added 50 litres of the oil to be bleached, and the fluids well stirred up for about two days; at the end of that time, 20 litres of boiling water and 5 kilos. of commercial hydrochloric acid are added; the liquid is again well stirred up; and, after two more days, the acid liquor is run off by means of the tap, and, having been removed, the oil is repeatedly washed with boiling water, until all the acid is removed from it.

Beer-Yeast as a Manure.—M. Bernier.—Beer-yeast contains from 7 to 11 per cent of nitrogen; it is easily decomposed—in common parlance, soon rotten. The author mixes 100 kilos. of it with 30 kilos. of slaked lime and 10 kilos. of gypsum, and thus obtains a pulverulent substance, which may be applied in agriculture instead of guano. It is well-known that, especially in summer, large quantities of this yeast are run off into sewers and altogether wasted.

Les Mondes, January 6, 1870.

This number contains the following original paper:—

Instantaneous Production of Artificial Precious Stones.—M Zehweskofski.—Many of our readers have seen that the ordinary newspapers have communicated some more or less sensational accounts concerning the instantaneous artificial preparation of precious stones. It appears that the author has discovered some peculiar silicic and aluminous ethers; but it is not true that these yield, on evaporation, precious stones, and certainly no diamonds, as reported by some newspapers, whose editors do not seem to know what diamonds are. Altogether, the communication (excepting the discovery of the ethers above alluded to) is a *canard*.

January 13, 1870.

Aurora Borealis Seen at Nantes.—L'Abbé Trébeden writes, that on the 3rd inst., at ¼ past 6 p. m. (local time) he observed a brilliant aurora borealis which occupied an arc of 70° of the horizon, and extended some 20° in height. The temperature of the air was at that moment 7·1°, and the reading of the barometer 768 m.m. The phenomenon lasted fully an hour, perhaps longer; but it became invisible on account of clouds coming up. The city of Nantes is situated in 47° 13′ N. latitude.

On the Nascent State.—M. St. Claire-Deville.—This paper is the first of a series which the author intends to publish in this periodical on a subject which cannot be well rendered in extract. We intend to return to this subject.

Influence of the Phases of the Moon upon the Height of the Barometer.—M Coloria.—The result arrived at is that there does not exist any definite relation between the height of the barometer and the synodic revolutions of the moon.

Action of Tobacco and Effects of Smoking upon the System.—Dr. Sée.

Comptes Rendus des Séances de l'Académie des Sciences, January 3, 1870.

This number, a great portion of which is devoted to the records of the proceedings of the elections of President Vice-Presidents, and *Membres du Bureau*, contains the fol-

lowing original papers and memoirs relating to chemistry and allied sciences:—

On the Nascent State.—M. St. Claire-Deville.—This paper is identical with that already briefly alluded to (see Chemical News, vol. xxi., p. 36; *Am. Repr., Mar.* '70, *page* 172).

Action of Magnetism upon Gases.—M. Trève.—This paper contains a first short account of a series of experiments made with perfectly pure gases enclosed in so-called Geissler tubes, and submitted to the action of the induction-spark and an electro-magnet of great force.

Origin of Nitrogen Gas Present in what is supposed to be Perfectly Pure Oxygen.—M. Houzeau.—The author mainly states that atmospheric air adheres with so great tenacity to all parts of the apparatus employed for the production of oxygen and hydrogen, that the author found it necessary to heat to redness even narrow tubes, in order to expel the air, while at the same time a rapid current of pure oxygen passed through the same.

Some Remarks on the Artificial Manufacture of Precious Stones.—M. Gaudin.—The author states, in reference to what has been done on this subject by M. Feil, that he (the author of this paper) made artificial precious stones in crucibles many years ago, but that it is far more difficult to obtain really good results by that method than by the use of the oxyhydrogen blowpipe, and that only by the use of the latter really hard stones, not acted upon by the file, can be made.

Motion of Chlorophyl Globules Under the Influence of Light.—M. Prillcux.—A botanico-physiological paper.

Manufacture of Platinised Looking-Glasses.—M. Jouglet.—Abstracted from another periodical.

Two Products from the White Agaricus.—M. Fleury.—The dried agaricus (a kind of mushroom) yields, on being treated with ether, after evaporation of that fluid, two substances—viz., a resin, $C_{51}H_{82}O_{10}$; and agaricic acid, $C_{16}H_{28}O_5$.

Toxicological Properties of Some Rosolates.—M. Guyot.—The author states that the rosolates of potassa, soda, and baryta do not at all act upon the skin; the soda and potassa salts are not poisonous when they are inwardly taken, or introduced into the animal system; rosolate of baryta is poisonous in strong dose, in consequence of the poisonous properties of the base itself.

January 10th, 1870.

Nitrous Acid.—M. Fremy.—The author considers this acid under the three following headings:—(1) Action of water upon nitrous acid. This decomposition is represented by the following formula:—

$$3NO_3+HO=NO_5,+2NO_2.$$

This reaction is modified, however, by the relative quantities of acid and water, as well as by the temperature. When the acid is in excess, there is only nitric acid and deutoxide of nitrogen formed. When a large quantity of cold water is brought into contact with nitrous acid, the latter dissolves in the water, and no decomposition whatever takes place; this solution is far more staple than one would at first think—even a boiling heat does not destroy it at once. (2) Reducing action of the acid.—In this respect, the aqueous solution just alluded to has some similarity with sulphurous acid, chloride of gold is reduced instantaneously, and permanganate of potassa is decomposed. Nitrous acid decomposes sulphuretted hydrogen precisely in the same manner as sulphurous acid does. The author discusses, at some length, the action of nitrous and sulphurous acids in their respective relations to the manufacture of sulphuric acid; and, from his observations, he comes to the conclusion that an excess of sulphurous acid gas in the leaden chambers, and too high temperature, are the real causes of the useless waste of nitrous compounds in the manufacture of sulphuric acid on the large scale. (3) Decomposition by means of hydrogen.—While experimenting on this subject, the author has discovered a new substance in the following manner:—Nitrate of potassa is calcined in a platinum crucible, and nitrite of potassa formed; this is dissolved in water, and the solution thus obtained submitted to the action of sodium amalgam. The nitrite becomes reduced, and the new substance is obtained, exhibiting the following properties:—It decomposes instantaneously, and at the ordinary temperature, the salts of gold, silver, mercury, and copper, yielding, with the three first-named, the pure metals, and, with the last, the hydrated peroxide. Even when an excess of alkali is present, permanganate of potassa solution is instantaneously decolourised; heated with an excess of alkali, ammonia and protoxide of nitrogen are given off, and the reducing properties are at once lost. The researches on this substance are not finished yet.

Eighth Memoir on the Electro-Capillary Phenomena. Part II. On the Electric Currents of the Muscles, Nerves, and Bones.—M. Becquerel.

Estimation of Weak Electro-Motive Force.—M. Becquerel.

Constitution of the Solar Aureola, and on the Phenomena Exhibited by Rarefied Gases Rendered Incandescent by means of Electric Currents.—Rev. Father Secchi, S.J.—A lengthy paper accompanied by several diagrams.

Manufacture of Tam-Tams and Cymbals.—MM. Riche and Champion.—This paper gives a description of the mode of manufacture of the metallic drums often imported from China under the name of gongs. The alloy made use of by the authors consists of 78 per cent of copper and 22 per cent of tin. The operations chiefly consist in a well-managed beating out and annealing of the disc, which is cast of a thickness of 23 m.m. originally.

Action of Dry Chlorine upon Dried Nitrate of Silver.—MM. Odet and Vignon.—The authors, referring to a former paper published by them on this subject, now state that there are two phases to be distinguished in the reactions which here take place—viz., first, chloride of azotyl is formed, and oxygen set free; and, secondly, the chloride of azotyl reacts upon the excess of nitrate of silver. The following formulæ represent these phases:—

$$1st.\quad \left.\begin{matrix}NO_4\\Ag\end{matrix}\right\}O_2+\left\{\begin{matrix}Cl\\Cl\end{matrix}\right\}=\left\{\begin{matrix}Cl\\Ag\end{matrix}\right\}+O_2+\left\{\begin{matrix}NO_4\\Cl\end{matrix}\right.$$

$$2nd.\quad \left.\begin{matrix}NO_4\\Cl\end{matrix}\right\}+\left\{\begin{matrix}NO_4\\Ag\end{matrix}\right\}O_2=\left\{\begin{matrix}Cl\\Ag\end{matrix}\right\}+\left\{\begin{matrix}NO_4\\NO_4\end{matrix}\right\}O_2.$$

Synthesis of Hydrosulphuric Acid.—M. Boillot.—The author states that, having filled gas jars with hydrogen, and having placed some sulphur in the same, the passing of an electric spark through the latter, igniting and volatilising it, produced a perceptible quantity of sulphuretted hydrogen.

Analysis of the Waters Contained in Arable Soils.—M. Schlœsing.—This interesting paper is chiefly made up of results placed in a tabulated form, and, hence, not well suited for useful abstraction.

Reply to M. Guadin's Paper "On the Manufacture of Artificial Precious Stones."—M. Feil.—A question of priority.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 17, 1869.

This number contains the following original papers:—

The Antecedents (Vorstufen) of Urea in the Animal Organism.—MM. Schultzen and Nencki.—This paper, communicated from the chemical laboratory attached to and forming part of the anatomical dissection rooms, contains the record of a series of experiments instituted

[English Edition, Vol. XXI., No. 531, pages 45, 46.]

with dogs in order to elucidate, and, if possible, explain, the mode of the formation of urea and the prodromi of that substance.

Iodide and Bromide of Mercury.—M. Oppenheim.—The iodine compounds of the alcohol radicals do not act upon bichloride and bibromide of mercury in the same manner. In the case of the iodides of the alcohol radicals and the bichloride of mercury, there is formed at once an organic chloride and red iodide of mercury; but when organic iodides are brought into contact with bibromide of mercury in alcoholic solution, no action takes pl ce. When, however, bibromide of mercury is dissolved in aceton, and the experiment repeated with this solution, a yellow crystalline substance is obtained; on investigation, this substance proved to be soluble in ether, to sublime without decomposition, and to have for its formula HgIBr. The authors observe that the formation takes place according to the formula $RI+HgBr_2=RBr+HgBrI$, and that its composition is a new proof of the correctness of the atomic weight of mercury=200.

Isomorphism of the Compounds of Mercury containing Two Atoms of Chlorine, Bromine, Iodine, and Cyanogen.—M. Groth.—A crystallographical paper illustrated by diagrams.

Critical Remarks upon the Paper Read by M. Thomsen "On the Estimation of the Heat Given Off by the Combustion of Organic Compounds."—M. Baeyer.

Cresylo-Purpuric Acid.—M. von Sommaruga.—The raw material employed by the author for his experiments is trinitro-cresylate of ammonia, an article of commerce known under the name of Victoria yellow. After having purified this salt by recrystallisation, it was dissolved in water, and yielded, on the addition of hydrochloric acid, trinitro-cresylic acid. Instead of treating this acid with cyanide of potassium, the author prefers to use the purified Victoria yellow at once, and obtains, on addition to that substance an aqueous solution of the cyanide just named, the cresyl-purpurate of potassa, $C_9H_6N_5KO_6$. When dry, this substance, on being suddenly heated, detonates. A concentrated solution of this salt yields, on being mixed with a concentrated solution of chloride of ammonium, the ammonia salt of the new acid—viz., $C_9H_6N_5(NH_4)O_6$.

Researches on Sandal-Wood.—M. Weidel.—After referring to some old researches on this subject, the author states that he exhausted 20 lbs. of the sandal-wood shavings, first, with boiling water, to which some caustic potassa had been added. The deep-red coloured liquid was neutralised with hydrochloric acid, whereby a bulky brick-coloured precipitate was thrown down. This substance was collected on filter, washed, and dried, and next treated with ether, the excess of the latter removed by means of distillation, the residue diluted with alcohol, and left to evaporate by itself. The author thus obtained, among several coloured substances, a colourless crystalline body, which is soluble in boiling alcohol. This substance, not hitherto known, has been called by the author "santal;" it is only readily soluble in dilute solutions of caustic alkalies, but these solutions soon become coloured while in contact with air, passing from red, through green, to a dirty brown. The alcoholic solution of santal is neutral to test paper, and is coloured deep red with perchloride of iron. Concentrated sulphuric acid dissolves santal, exhibiting a lemon-yellow coloured solution; formula of the dry substance, $C_8H_6O_3$. The author also found a cinnabar-red coloured crystalline material, which he called "santaline," though it is not quite identical with the santalin of M. Meier; according to M. Weidel's analysis, this santalin is $C_{14}H_{12}O_4$. It is probable that santal is in some manner connected with santalin, but this point is a subject for ulterior investigation.

Double Cyanogen Compounds.—M. Weselsky.—This lengthy memoir is divided into the following sections:—Double cyanides, having the general formula $BaCy_2.R_2Cy_2$; sodiumcobaltocyanide, $Na_6CO_2Cy_{12}.4H_2O$; ammoniumcobaltocyanide, $Am_6CO_2Cy_{12}$; phenylammoniumcobaltocyanide, $(C_6H_8N)_6.CoCy_{12}$. And a series of more and more complicated bodies, as instance of which we quote—phenylammoniumcobaltocyanide, phenylammonium hydrate—

$$(C_6H_8N)_6Co_2Cy_{12}.2(C_6H_9NO).$$

Preparation and Properties of Hydrate of Chloral.—M. Thomsen.

Preparation of Selenic and Selenious Acid.—M. Thomsen.—Selenium is acted upon with concentrated nitric acid, and the solution obtained is evaporated until selenious acid begins to sublime; the residue is dissolved in water. This solution may contain, besides selenious acid, some sulphuric and selenic acid; in order to separate these from each other, baryta water is added. Since selenite of baryta is readily soluble in an excess of selenious acid, the addition of baryta water is continued until a small quantity of the fluid having been filtered does not yield any longer a permanent precipitate on the addition of some more baryta water. The fluid, having been filtered, is evaporated to dryness and submitted to sublimation; the selenious acid thus obtained is quite free from selenic and sulphuric acids. Selenic acid is prepared from this selenious acid by dissolving the latter in water, precipitating this solution with nitrate of silver; the insoluble selenite of silver thus obtained is shaken up with a mixture of water and bromine until the latter is in slight excess. The solution, having been filtered and concentrated by evaporation, yields selenic acid, quite free from sulphuric or selenious acid.

Simple Method for Recovering Iodine from Iodide of Mercury.—M. Henry.—The iodide of mercury is digested with water to which granulated zinc or iron borings are added. A soluble iodide of zinc or iron is obtained; from which the iodine is separated by means of sulphurous acid.

Parachlorotoluidine.—MM. Henry and Radziszewski.—The substance is a solid, hard, brittle, white-coloured body, fusing at 85°, and boiling, without decomposition, at 243°.

Contribution to the History of Sulphuretted Ureas.—Dr. A. W. Hofmann.—A lengthy and concisely-written memoir, not well suited for abstraction.

Some Ethers of Cresol.—M. Fuchs.—The author describes—Ethylcresol, $C_9H_{12}O$; ethylparaoxybenzoic acid, $C_9H_{10}O_3$; ethylencresol, $C_{16}H_{18}O_2$; acetylcresol, $C_9H_{10}O_2$.

Paratoluidine and Bromotoluol.—M. Wallach.—A critical review of M. Rosenstiehl's labours on this subject.

Revue Hebdomadaire de Chimie, January 13, 1870.

Action of Sulphuretted Hydrogen upon Hydrated Peroxide and Peroxide of Iron at the Ordinary Temperature of the Air.—M. Brescius.—The author has investigated this reaction by means of the following experiment:—Chemically-pure hydrated peroxide of iron was placed in a glass tube, and all the air expelled by means of a current of carbonic acid gas, which was made to pass, previously to reaching the tube, through freshly-precipitated carbonate of iron suspended in water, in order to remove from the carbonic acid every trace of atmospheric oxygen. A current of sulphuretted hydrogen (also free from air) was then passed over and through the hydrated peroxide for twenty-four hours, and the excess of the latter gas removed by a current of dry and pure carbonic acid, care being taken to bring the temperature to 50°, in order simultaneously to dry the sulphuret obtained. The product thus obtained oxidises only very slowly in contact with dry air, and contains hardly more than mere traces of free sulphur. The author, therefore, concludes that the reaction takes place according to Berzelius's view, represented as fol-

lows:—$Fe_2O_3+3HS=Fe_2S_3+3HO$. When perfectly pure and dry peroxide of iron is experimented with under the same conditions, no reaction whatever ensues.

Action of the Oxygen of the Air upon Sulphuret of Iron.—M. Wagner.—According to the author, sulphuret of iron does not, when exposed to air, change into sulphate or sub-sulphate, but is converted into sulphur and peroxide of iron. Only traces of sulphuric acid are formed at the ordinary temperature; and only when more heat is applied is this acid more abundantly formed. In order to prove this by experiment, monosulphuret of iron was carefully prepared, and divided into three portions. One of these was kept constantly moist, and at nearly 100°, during three weeks. The second was also kept moist, and left at the ordinary temperature of the air. The third, after having been previously dried, was, for three weeks, left in contact with dry air at the ordinary temperature [the sulphuret was dried by means of a current of illuminating gas, at 100°, since a current of air, dried by means of strong sulphuric acid, oxidises the material]. The results of the analysis of these samples, recorded percentically, gave for—(I.) Sulphur, 24·35; sulphuric acid, 7·76; ferrous oxide, 61·72; ferric oxide, 6·17. (II.) Sulphur, 28·32; sulphuric acid, 0·96; ferrous oxide, 61·51; ferric oxide, 9·21. (III.) Sulphur, 27·94; sulphuric acid, 2·39; ferrous oxide, 46·43; ferric oxide, 23·24.

Platinised Looking-Glasses.—M. Jouglet.—The platinising compound is prepared in the following manner:—100 grms. of very thin platinum foil is dissolved in aqua regia, the solution carefully evaporated to dryness, the solid chloride next placed on a triturating marble, and gradually mixed with essential oil of lavender. When 400 grms. of the latter have been incorporated with the chloride, the mixture is placed in a porcelain capsule and left standing for several days, the fluid is decanted from any sediment, and filtered as flux. For the above-named quantity of platinum, the following ingredients are used:—25 grms. of litharge and 25 grms. of borate of lead, mixed and triturated together with about 10 grms. of essence of lavender; this mixture is next mixed with the platinising fluid. After a layer of platinum has been formed upon the glass, it is fixed by burning it in by placing the glass in peculiarly-constructed muffles.

Depositing Copper upon Cast-Iron.—M. Weis-Kopp.—The pieces of cast-iron are first placed in a bath made of 50 parts of hydrochloric acid, at 15° Beaumé (sp. gr., 1·105), and one part of nitric acid; next, in a second bath, composed of 10 parts of nitric acid, 10 parts of chloride of copper, dissolved in 80 parts of the same hydrochloric acid as just alluded to. The objects are rubbed with a woollen rag and a soft brush, next washed with water, and again immersed until the desired thickness of copper is deposited. When it is desired to give the appearance of bronze, the copper surface is rubbed with a mixture of 4 parts of sal ammoniac and 1 each of oxalic and acetic acids dissolved in 30 parts of water.

Cosmos, January 15, 1870.

Universal Galvanic Battery.—M. Delaurier.—The author describes, at great length, and accompanied by a woodcut, a Bunsen cell modified by him. He uses an impure chromic acid, and a mixture of persulphate of iron and sulphuric acid. How the impure chromic acid is prepared is not mentioned. Instead of sulphuric acid, a solution of common salt (1 part in 10 of water) is often applied, and the amalgamation of the zinc is dispensed with; this arrangement appears, according to the statements made, to be satisfactory in many instances The intensity of the action of the cell when chromic acid, persulphate of iron, and sulphuric acid are used, is very great, and the vapours of hyponitric acid, so deleterious with the Bunsen cells, are, of course, avoided.

Gases in Arable Soil.—M. Hervé-Mangon.—Akin to most porous substances, arable soil has the property of condensing gases. The author finds that the quantity of gases thus condensed varies in bulk (for the same quantity of soil) from 2 to 10 volumes of gas.

Railway from Arequipa to Puno and Cusco (Peru).—The highest point above sea level of this railroad is 4633 metres (15,056 English feet)*—that is to say, more than twice the height above the level of the sea that any existing railroad has reached. At the altitude just named, the air is only half as dense as at the surface of the ocean; in other words, when the average height of the barometer at the last-named surface is taken at 28 inches at the height alluded to, its average reading will be only 14 inches.

Archives Nerlandaises des Sciences Exactes et Naturelles, vol. xiv., 1869.

This periodical is published at irregular intervals of time, in volumes containing from six to twelve sheets 8vo. The editor, Dr. E. H. von Baumhauer, the Secretary of the Holland Society of Sciences at Haarlem, is assisted by a number of eminent scientific men. This volume contains the following original papers and memoirs:

Observations on the Periodical Errors of Micrometer Screws made During the Latest Re-Arrangement of the Astronomical Observatory of Leyden University.—M. F. Kaiser.

Improved Method of Direct Estimation of Iron in the State of Peroxide by means of Hyposulphite of Soda.—M. A. C. Oudemans, jun.—Reserved for full translation, since it bears upon an important subject.

Synthesis of Terephthalic Acid.—M. A. C. Oudemans.—After referring to the labours of M. Carius on the subject of the products of the oxidation of benzol, the author states that he found that, besides formic and phthalic acids, there is also formed terephthalic acid, $C_8H_6O_4$. The quantity obtained of that substance is, however, very small. The preparation, and some of the reactions of this acid, are described at great length.

Specific Gravity of some Saline Solutions.—M. A. C. Oudemans.—This paper contains a series of tabulated results of the specific gravity of aqueous solutions of the following salts:—Crystallised sulphate of magnesia, at 14°, and in quantities of from 1 to 40 per cent of the quantity of water; crystallised nitrate of magnesia, at 14°, and in quantities of from 1 to 49 per cent of the quantity of water; crystallised chloride of magnesium, $Mg''Cl_2+6aq$, at 14°, and in quantities of from 1 to 48 per cent of the quantity of water; crystallised nitrate of manganese, at 8°, and in quantities of from 1 to 71 per cent of the quantity of water; crystallised acetate of lead, at 14°, and in quantities of from 1 to 33 per cent of the quantity of water; crystallised nitrate of zinc, at 14°, and in quantities of from 1 to 50 per cent of the quantity of water.

Application of Avogadro's Theorem to Chemistry.—Dr. J. W. Gunning.

Albuminous Substances of the Blood.—Dr. Heynsius.—A lengthy and very valuable chemico-physiological memoir.

General Registering Apparatus.—Dr. Heynsius.—To this paper is added an engraving, essential for the proper understanding of the subject.

Means of Preserving Wood from being Attacked by the Teredo Navalis.—Dr. E. H. von Baumhauer.—This paper, too lengthy for useful abstraction, contains the results of experiments made with various kinds of wood, among these several samples brought on purpose, from the Netherlands' West Indies; as well as the results of impregnating European wood with various preservative and other

* The height of Mont Blanc is, according to Tralles, 14·793.

substances. The main result is that, among the latter, creosoting is the only active agent, provided the creosote applied contains a large quantity of carbolic acid and the impregnation be complete.

Absolute Expansion of Mercury according to M. Regnault's Experiment.—M. Bosscha.

Method of Analysis of Milk.—Dr. E. H. von Baumhauer.—A valuable and extensive memoir on this subject, but, owing to the engravings and large number of tabulated forms added, not suited for useful abstraction.

Nature of the Fluids Enclosed in some Minerals.—MM. Vogelsang and Geissler.

Mineral Oils of the Netherlands' East Indian Possessions.—Dr. E. H. von Baumhauer.—A very valuable memoir not only for the knowledge it contains on the subject, but owing to its containing compilations from an immense number of analyses and researches on mineral oils dispersed through a large number of periodicals.

Periodical Evolution of Gas in the Protoplasma of the Living Arcellæ.—M. Hartogh Heys van Zouteveen.

Electrical Irritation of Amibæ and Arcellæ.—M. Hartogh Heys van Zouteveen.

NOTES AND QUERIES.

Detection of Opium in Tobacco.—Can you kindly inform me how best to detect small quantities of opium when present in tobacco? Neither Fresenius, nor any other work on analysis that I know of, gives any process that I have found available. By doing so, you will greatly oblige.—E. Morton.

Detection of Opium in Tobacco.—(Reply to E. Morton.)—Make an infusion of the cigars in water slightly acidulated with acetic acid. Filter, and add basic acetate of lead till all the colouring matter is nearly precipitated; again filter and digest during a whole day with a little animal charcoal. Collect the charcoal, and boil it in alcohol twice or three times, using altogether about a pint of that solvent. Evaporate this solution to dryness on a water-bath, and treat the extract, first with water rendered freely alkaline by ammonia, then with ether, and lastly with alcohol; this is now evaporated, and the residue tested for morphia as usual. 0·02 grms. of opium may be detected by this process in a single cigar.—John Muter, Ph.D.

Detection of Opium in Tobacco.—(Reply to E. Morton.)—Although it is hardly likely ever to occur that tobacco should be adulterated with opium, the latter substance might be detected by the reactions of meconic acid. Opium does not burn well at all; neither does the *tandoo* (*i.e.*, its aqueous and inspissated extract) do so, for it is a well-known fact that opium smokers can only keep the small quantity they use alight by means of the aid of a spirit-lamp, or by means of an addition of some easily-burning substance to the extract. Moreover, opium is too expensive a drug to adulterate tobacco with, and those who use opium (as, unfortunately, too many do in this country) employ it in a pure state.

Fancy Colouring of Metals.—The colouring matter of small objects in metal has recently occupied the attention of manufacturers and chemists, and M. Pushec, a German chemist, gives the following recipes for the application of sulphur to the purposes referred to:—(1) A solution is made in the following manner:—Dissolve 4 ozs. of the hyposulphite of soda in 1¼ pints of water, and then add a solution of 1 oz. of acetate of lead in the same quantity of water. Articles to be coloured are placed in the mixture, which is then gradually heated to boiling-point. The effect of this solution is to give iron the effect of blue steel; zinc becomes bronze; and copper or brass becomes successively yellowish, red, scarlet, deep blue, light blue, bluish white, and, finally, white, with a tinge of rose. This solution has no effect on lead or tin.—(2) By replacing the acetate of lead in the solution by sulphate of copper, brass becomes first of a fine rosy tint, then green, and finally of an iridescent brown colour. Zinc does not colour in this solution—it throws down a precipitate of brown sulphuret of copper; but if boiled in a solution containing both lead and copper, it becomes covered with a black adherent crust, which may be improved by a thin coating of wax.—(3) If the lead solution be thickened with a little gum tragacanth, and patterns be traced with it on brass, which is afterwards heated to 212°, and then plunged in solution No. 1, a good marked effect is produced.

Detection of Fatty Oils from Seeds of Cruciferæ.—With reference to the method for detecting these oils by boiling with caustic potassa in a silver capsule, M. Grehant is probably not aware that his process is no novelty. It was known in England prior to the year 1861, and is described in a work bearing that date.—J. W. Slater.

Test for Soaps.—In the Chemical News (vol. xx., p. 44; *Am. Repr., Sept.* '69, *page* 167), Professor Schulze proposes to estimate the goodness of soaps by observing the relative quantities required to unharden a standard sample of water—an inversion, in fact, of Clarke's water-test. The proposed method takes for granted (tacitly, at least) that the most caustic soap (*i.e.*, the one containing the largest amount of alkali) is necessarily the best—a totally false assumption. A soap may be bad from presence of sophistications, from imperfect saponification, or from either excess or deficiency of alkali; and it is called good only when, in addition to being genuine and thoroughly "cooked," it contains alkali and fat duly balanced, such balance varying according to the purpose in view. Professor Schulze's test might place an adulterated but caustic soap upon the same level with one genuine but mild, or might even lead us to prefer the former.—J. W. Slater.

Fermentation of Sugar.—(Answer to John Bowring.)—Alcoholic fermentation, upon which you have fixed your ideas, is not the only fermentation of the sugar-refinery, lactic and acetic fermentations being quite as prevalent. My experience does not enable me to say whether hydric sulphide actually *produces* fermentation of either kind in sugar solutions, but it most unquestionably *favours* fermentation. You surely do not require instructions for the preparation of hydric sulphide. You seem to forget that the sulphide referred to is generated *in* the solution, not introduced after having been generated in a separate apparatus.—W. A.

Estimating Manganese by Bunsen's Method.—The following note has been sent us by Mr. Edward Sherer, as an addition to his paper "On the Estimation of Peroxide of Manganese in Manganese Ores" (Chemical News, vol. xx., p. 304; *Am. Repr., Feb.*, '70, *page* 84). He there stated that in estimating the manganese by the method of Bunsen, the iodine solution gave higher results after standing twenty-four hours than before. He now adds:—These higher results are caused by the liberation of iodine by spontaneous decomposition of hydriodic acid, set free by hydrochloric acid, distilled over during the process, as the following experiment shows:—A few drops of hydrochloric acid were added to a solution of iodide of potassium. The solution remained for some hours colourless, but, after standing twenty-four hours, had become quite yellow, and was found to contain free iodine sufficient to indicate 8 per cent of peroxide of manganese when titrated with hyposulphite.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 *Broome Street, New York.*

E. K.—We do not intend to publish the lectures spoken of.

F. H. Button.—You had better advertise.

E. Halliwell.—"Laboratory Teaching," by C. L. Bloxam, published by Churchill, will answer your purpose best.

R. Reynolds.—Received, with thanks.

A. Hedley.—Dr. Lunge, of South Shields, will be able to give you full information about the use of aluminate of soda in soap making.

J. Watkins.—To prepare hydrochlorate of aniline and tartrate of aniline you must saturate aqueous solutions of the respective acids with aniline.

C. P. Bahin and others.—You will see the explanation in the present number.

J. T. Thompson.—A work by Dr. Letheby, "On Food," is just published by Messrs. Longmans.

Prof. J. Laurence Smith (Louisville).—Your letter and enclosure have been received, and shall be attended to. The Photometer invented by the Editor is manufactured by Messrs. Elliott and Co., of Charing Cross, London.

W. L.—You had better advertise for the information you require.

J. W. Slater.—Received with thanks.

Pb.—We are not aware of any method which will practically separate lead and zinc on the large scale, other than those contained in Crookes and Röhrig's "Metallurgy," which you quote. A method of separating small quantities of lead from much zinc, without having recourse to the costly subsidence method used at Vieille Montagne, would be of the highest importance.

Books Received.—"Rinderpest: Its Prevention and Cure, and Gypsum as a Sanitary Agent." Edinburgh: William P. Nimmo. London: Simpkin and Co. "On the Ozonometer for the Observation of Ozone with an Aspirator; Instructions for its Use, and the Results obtained," by John Smyth, jun., M.A., F.M.S., &c. (From the Author.) "The Year-Book of Photography and Photo News Almanac for 1870," edited by G. Wharton Simpson, M.A., F.S.A. London: Piper and Carter. "Our Domestic Fire-Places," a New Edition, by Frederick Edwards, jun. London: Longmans, Green, and Co. "The Body and its Health, for Primary Schools," by E. D. Mopother, M.D. Second Edition. Dublin: John Falconer. "Second Annual Report of the Committee of the Manchester National Society for Women's Suffrage." "Notes for Students in Chemistry, Being a Syllabus of Chemistry and Practical Chemistry," by Albert J. Bernays, Ph.D., F.C.S. Fifth Edition. London: John Churchill and Sons. "A Manual of Qualitative Analysis," by Robert Galloway, F.C.S. Fifth Edition. London: John Churchill and Sons.

AMERICAN SUPPLEMENT.

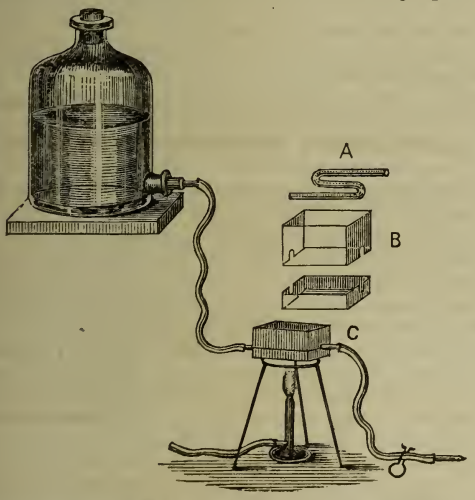
New York, March, 1870.

To Our Readers.

The editor of the *American Supplement* will be very glad to receive articles on chemical subjects, and takes this method of inviting contributions. The editorial work of the London *Chemical News*, which we reprint, is so complete that we cannot supplement it if we would. It gives a full *résumé* of all the chemical news of Great Britain and the Continent, and is by far the fullest chemical journal published. We desire to make the American Supplement as full a record of what is done this side of the water, and request the aid of all who are engaged in this field of investigation.

A Laboratory Convenience.

Mr. H. W. Vaughan, Assistant in the Laboratory of Brown University, at Providence, has devised the new washing arrangement shown in the following figure.



A is a tube of hard glass bent in the form of an *S*.

B is a copper box made in two parts. The lower part is a shallow sand-bath; in its ends openings are cut to accommodate the glass tube A, when it is placed in the sand. The upper part slips directly into the lower part, and is for the purpose of preventing the spilling of the sand.

C represents the sand-bath containing its glass tube in place. The *S* tube is connected by a rubber tube, on the one hand with the supply of distilled water at a higher level, and on the other hand, with a glass jet.

When a precipitate is to be washed with cold water, you have only to loosen the nipper tap on the delivery tube, and direct the stream.

If *hot water* is desired, light a single Bunsen burner under the sand-bath. In one or two minutes after lighting the lamp the hot water is ready, and the heat is abundant to furnish a steady supply of almost boiling water.

By use of this simple arrangement you are saved the annoyance of blowing from the lungs, an annoyance which is especially observed when hot water is to be used. In connection with the filter-pump, where a continuous stream of water is necessary, we have found it especially convenient.

Professor John M. Appleton, of Brown University, speaks very highly of the utility of this apparatus.

The Purification of Coal Gas, and the Gas Nuisance in New York.

Report of Prof. C. F. Chandler to the Metropolitan Board of Health of New York.

(*Continued from our last number.*)

IV.—HISTORY OF THE GAS NUISANCE.

For years the citizens of New York have complained of a peculiarly offensive smell which was perceived throughout the city to a greater or less degree, according to the weather. This smell was noticed at particular hours of the day, and pervaded large districts, making it impossible to open the windows during its prevalence. By many this smell was attributed to the gases from the sewers, but it was easily demonstrated that the sewers did not, as they do not now, send out offensive gases. The enormous quantities of Croton water used throughout the city make it impossible for the sewers ever to become specially offensive. The smell was peculiar, and was recognized at once by every chemist, and by every one familiar with the manufacture of gas, as the smell of the foul lime which had been used for purifying gas.

The first special complaint against a gas company that I find on record, is that of Dr. E. H. Janes to the Board of Health, against the Manhattan Company, dated April 24, 1866, and printed in the annual report of the Board for that year. The subject was at that time referred to the Sanitary Committee. On the 30th of April following, a committee of the Citizens' Association conferred with the Sanitary Committee on the subject; Professor R. O. Doremus and Professor Samuel St. John appearing as members of the citizens' committee, and the gas companies being represented by some of their officers. As a result of this conference, the Manhattan and New York companies at once turned their attention to the subject and sought means to prevent the nuisance which they admitted to exist. Nor were their efforts in vain. The Manhattan Company made a number of experiments with a view to destroying the foul gases of the refuse lime, and finally introduced the ventilating process which I have already alluded to, and which, with the improvements recently introduced, seems to effectually remedy the nuisance. The New York company was equally active, and after considerable investigation decided to give up lime purification altogether, and very judiciously introduced the oxide of iron in its place. Thus the largest companies on the island, which supply all the gas consumed below Thirty-fourth street, promptly responded to the suggestions of the sanitary committee and removed the cause of complaint. As these two companies manufacture four-fifths of all the gas produced on the island, and own all the gasworks situated below Forty-first street, a great improvement was at once noticed.

The Metropolitan Company, however, which supplies gas to that portion of the city between Thirty-fourth and Seventy-ninth streets, paid no heed to complaints of the citizens, but continued to send out the odors of foul lime. As this company does not manufacture more than one-fifth of the gas supplied to this city, the nuisance was not, however, as general as before. Its works are situated at the foot of West Forty-second street, and the odors are often blown

westward, away from the island. In certain kinds of weather, however, the smell was diffused throughout the city, and complaints were not rare. Some attempts were made to coerce the company, but all responsibility for the smell was stoutly denied by the officers. The members of the Board of Health were on the alert with a determination to compel the offending parties to follow the example of the other companies.

On July 5, 1868, Dr. Stephen Smith, Sanitary Commissioner, and Dr. Elisha Harris, Sanitary Superintendent, noticed the unmistakable smell of foul lime in Thirty-fourth street. They consulted the neighboring vanes, and found that the wind was blowing from the northwest, and walking in this direction, guided by the odor, they came to the Metropolitan Gas Works in West Forty-second street, when they found that a purifier had just been emptied, and the pile of foul lime was still warm and reeking with offensive gases. When these facts were reported to the Board of Health, an order was at once issued, dated July 14, declaring the manufacture of gas at the foot of West Forty-second street to be a nuisance, and ordering the same to be discontinued, except it be conducted by a process that will not allow any deleterious gases or odors detrimental to health to escape into the external air.

Mr. Zollikoffer, the president of the Metropolitan Company, at once requested an opportunity to be heard in defence of the company; and on August 10 he appeared by counsel and showed by his witness that he employed the best coals and purified by the best process, and that the gases evolved by the foul lime were anything but unhealthy—were, indeed, a specific for the whooping-cough and other diseases. The attorney for the Board of Health showed by his witness that the purification as conducted by the Metropolitan Company was necessarily a nuisance, but one that could be easily avoided by following the example of either of the other city companies. The hearing was then adjourned to August 13. On that day the counsel presented a memorial from the gas company, signed by the president. In this they first plead the inexperience of youth, the company being the youngest on the island. They then state that they never heard it even suggested that purification by dry lime was in any way offensive till they received the order of July 14. This is a somewhat remarkable statement, inasmuch as every book on gasmaking admits the nuisance, and since the other companies had, two years previously, in response to the Board of Health, investigated the matter and made the necessary changes, all the particulars having appeared in the daily papers from time to time.

Further, while they protest against the adjudication of the Board of Health that their process of purification is a nuisance, they avow their willingness to try any method which science may suggest and experiment demonstrate to be a better one than that which they are using; and finally requesting that the hearing be postponed till March 1, 1869, that they may experiment on improved methods of purification. The Board finally consented to a postponement of several months.

On February 6, 1869, the hearing was resumed. The gas company had enjoyed a respite nearly six months for this special object, and on a distinct written promise of making experiments; and had not actually made a single experiment during the entire period. One thing only had been done—they sent a man to Europe to learn what processes of purification were in use there. He had returned, but great care was taken when the hearing was resumed not to put him on the witness stand, for his written report was a complete confirmation of all that had been claimed by the witness for the Board of Health with regard to the improved processes of purification there and for preventing nuisance. What did the Metropolitan Company do then, after making written promises and saying so much about good faith, &c.? They made no experiments; did not follow the advice of the man they had sent to Europe; did not do what either of the other New York companies had done to mitigate the nuisance, but at the end of six months appeared by counsel, with distinguished chemical experts, to defend the stench-producing method of purification. For several days the hearing was continued, and nearly 200 printed pages of testimony taken.

I will do justice to Professor Silliman, who was called to testify by the gas company, by stating that while we differed as to the expediency of introducing iron purification instead of lime, he stated clearly and unequivocally on the cross examination that the process of purification as conducted by the Metropolitan Company was necessarily a nuisance, and that by using simple precautions this nuisance could be avoided. This was all that the Board of Health was called upon to prove, and the admission of this by their own witness was evidently understood by the gas company as equivalent to losing their case. So they presented another memorial, or, rather, a set of resolutions, in which they again proposed to experiment. This was on March 4, and the hearing was then postponed till March 22, the company solemnly stipulating to introduce and test the iron or some other improved process.

When March 22 arrived the company again made excuses. "In order to introduce the iron process it was necessary to place false bottoms of perforated plank in the purifiers, and there was only one man in New York who could bore the holes, and he had been busy boring holes for some one else." Still the patience of the Board of Health held out, especially as a prompt enforcement of the order of July 14 might have thrown into darkness all that portion of the city lying between Thirty-fourth and Seventy-ninth streets. Finally the gas company actually began to experiment, but in a very original way. They engaged a man to make a soap with which to wash the smell out of the foul lime. A considerable quantity of it was used, and the members of the Board of Health and several other gentlemen were invited to witness the success of the operation. But the soap did not answer; it was tolerably effective on the upper layer of foul lime, but left the lower five or six layers as offensive as ever.

At last an iron mixture was procured; not one of those, however, which the messenger to Europe had seen in successful operation, and minutely described in his written report; nor yet the one in use by the New York Gas Light Company, but a mixture which was once used somewhere in New Jersey and subsequently abandoned—a mixture of Spanish brown, shell lime, and sawdust. Half the purifiers were filled with this mixture, while the other set were filled with lime as usual. They went through the motions of using this mixture in half the purifiers during most of the past summer, though the gas was actually purified, I think, by the purifiers containing lime. At all events, the mixture did not work, as might have been expected, and this autumn, as soon as the consumption of gas increased, the mixture was thrown out and the purifiers were again filled with lime. So this company has now

gone back to the old process, and in spite of all the evidence to the contrary, and all the time and money expended in bringing out that evidence, it still stubbornly denies the fact that foul lime creates a nuisance, or that any improvements have been made in gas purification.

The offensive process is now in full operation, and, more than that, the foul lime is actually used to fill in a pier. This is specially objectionable, as it has already happened in both London and Dublin, that in making excavations for sewers in places where foul lime had been used for filling in, the workmen were killed by the gases evolved. Five men were killed at one time in this manner in London, in 1849.

Such is the history of the gas nuisance in New York, brought down to date.

V.—WHAT THE METROPOLITAN GAS COMPANY MIGHT DO.

This company has probably spent nearly $10,000 for expert fees, counsel fees, sending to Europe the man whose evidence was suppressed and whose advice was not followed, time of employés, printing 200 pages of evidence, &c, all apparently with the design, not of suppressing the nuisance, but of defeating the honest efforts of the Board of Health in behalf of the citizens of New York. Suppose the officers of this company were really acting in good faith, with a sincere desire to obviate the nuisance, they could at once introduce a better process for purification, a cheaper process, by which they could save $10,000 per annum, or they could retain their present process and ventilate the foul lime. Let them follow the example of either of the neighboring companies, use the iron process of the New York Company, or the ventilating process of the Manhattan Company, or they may select any one of the improved iron processes now used in Europe. All that is asked of them is that they manifest the same willingness to direct their efforts to the management of their business in a manner most conducive to the health and comfort of the city, as was so promptly manifested by the other companies.

VI.—CHANGES REQUIRED.

The introduction of an iron process would require little if any change in the apparatus. Some iron mixtures are employed in exactly the same iron boxes with trays, as the company is now using for lime, while the greatest change that could be necessary would consist simply in taking out the movable trays and introducing a flooring of plank, perforated with auger-holes. A few hours would suffice to make the change; in fact, the plank flooring is already on the ground. A few days would be required to procure the necessary material. As there are two sets of purifiers, either of which could, in case of necessity, be made to purify all the gas made by the company, the change could easily be made without any serious interruption. Until within a short time, the New York Gas Company has been obliged to purify more gas than the Metropolitan Company now makes with purifiers of no greater capacity than one of these two sets. To introduce the ventilating process, considerable additions would be required to the apparatus. A suitable engine, a blower, a washer, and a supplementary purifier for the air used in ventilating would be required, besides a considerable length of mains and the necessary connections. These additions would involve an outlay of several thousand dollars, and some months would be consumed in procuring and erecting them.

VII.—THE AMMONIA WORKS IN EIGHTEENTH STREET.

I cannot consider this report completed until I have referred to the peculiar odor which is evolved in West Eighteenth street, and which is attributed by many to the Manhattan Gas Works. I refer to the odors which escape from the Ammonia Works in that street. The ammoniacal liquor of the Manhattan Works is sold to parties who manufacture from it ammoniacal salts. This liquor contains sulphide, cyanide, and sulphocyanide of ammonium, carbonate of ammonia, and various other compounds which are offensive, but whose exact nature is not known. With careful management the treatment of this liquor need not cause offence, but it is so conducted at these works as to send forth a very disagreeable odor, which is mistaken by persons not familiar with the business for the odor of foul lime. I have noticed this odor, at some distance from the works, almost every time I have visited the neighborhood. The proprietors of the works should be induced to modify their process in such a way as to prevent this nuisance.

SPECIMENS.

In conclusion I beg leave to submit a few specimens of the bog iron ore and oxide of iron mixtures, which I collected in Europe this summer, and which are now in actual use in Liverpool, London, Paris, &c.

Respectfully yours,

C. F. CHANDLER, Ph.D.,
Chemist to the Metropolitan Board of Health.

Recent Chemical Patents.

Issued January 4, 1870.

98,466.—Composition for Dyeing and Coloring Leather, Hides, and Skins.—C. Bond, New York.

98,517.—Manufacture of Artificial Stone.—J. M. Ordway, Jamaica Plains, Mass.

98,652.—Apparatus for Tanning Hides and Skins.—W. Y. Warner and J. Crooks, Wilmington, Del.

Issued January 11, 1870.

98,658.—Process of Cleaning Cotton Waste and other Fibres from Oil, etc.—H. M. Baker, Washington, D. C.

98,712.—Mode of Treating Vegetables to Obtain Fibre for Paper, etc.—J. A. Rothe, Philadelphia, Pa.

98,728.—Composition resembling Horn.—W. M. Welling, New York.

98,758.—Process of Preserving Green Corn.—W. L. Gilroy, Philadelphia, Pa.

98,784.—Treating Whiskey and other Spirits.—O. Marland, Boston, Mass.

Issued January 18, 1870.

98,854.—Explosive Compound.—C. Dittmar, Charlottenburg, Prussia.

98,883.—Mode of Producing Light by the Combination of Solid and Liquid Hydrocarbons.—J. Phillips, Cologne, Germany.

98,884.—Material for Tanning, Dyeing, and for other purposes.—F. P. Porcher, Charleston, S.C.

98,896.—Tanning and Stuffing Leather.—W. B. Brittingham, La Fayette, Ind.

99,007.—Alloy of Manganese.—E. Savage, West Meriden, Conn.

Issued January 25, 1870.

99,062.—Manufacture of Artificial Stone.—F. Coignet, Paris, France.

99,069.—Explosive Agent called "Xyloglodine."—C. Dittmar, Charlottenburg, Prussia.

99,070.—Manufacture of Xyloglodine and other Explosive Agents.—C. Dittmar, Charlottenburg, Prussia.

99,105.—Method of Fixing Pigments to Fibrous and Textile Materials.—A. Paraf, New York.

99,141.—Process of Extracting, Manufacturing, and Refining Sugar.—J. E. Boivin and D. Loiseau, Paris, France.

99,175.—Rectifying Whiskey during Distillation.—H. Fake, Williamsburg, N.Y.

99,180.—Preserving Meat.—H. Gahn, Upsala, Sweden.

99,186.—Drying, Preserving, and Coloring Wood or other Fibrous Material.—H. Haupt, Philadelphia, Pa.

99,192.—Batteries for Electrotyping.—P. S. Hoe, New York.

99,248.—Manufacture of Parchment-Paper.—A. J. Sheldon, Buffalo, N.Y.

99,250.—Process of rendering Lard, Tallow, and other Fats.—A. Smith, Baltimore, Md.

99,251.—Process of Treating Fish to Obtain Oils and Fertilizers.—A. Smith, Baltimore, Md.

99,253.—Process of rendering Rancid Animal Fats, and for Disinfecting the Gases Evolved.—A. Smith, Baltimore, Md.

Issued February 1, 1870.

99,367.—Manufacture of Iron.—D. Stewart, Kittanning, Pittsburgh, Pa.

99,368.—Manufacture of Iron.—D. Stewart, Kittanning, Pittsburgh, Pa.

99,387.—Compound for Bating and Raising Hides.—G. W. Adler, Philadelphia, Pa.

99,468.—Manufacture of Soap.—H. A. Pease, Hartford, Conn.

99,496.—Dye for Coloring Wool.—G. W. Talbot, Providence, R.I.

99,500.—Manufacture of Oils from Petroleum.—C. Toppan, Wakefield, Mass.

Reissues.

3,487.—Purging and Draining Sugar.—W. H. Guild, Brooklyn, N.Y.

3,804.—Brewing Ale, Beer, &c.—J. McCormick, Boston, Mass.

3,808.—Process of Treating Silver Ores.—C. Stetefeldt, Austin, Nevada.

3,813.—Varnish.—D. R. Averill, New Centreville, N.Y.

3,814.—Manufacture of Varnish.—D. R. Averill, New Centreville, N.Y.

3,816.—Treatment of Leather.—N. C. Russell, Gloversville, N.Y.

NEW PUBLICATIONS.

Die Darstellung krystallisirter Kieselsaure auf trockenem Wege. By Prof. Gustav Rose. A paper read before the Berlin Academie, June 3, 1869. 14 pp.

Prof. Rose describes the various methods by which crystallized silicic acid has been prepared in the wet way. Senarmont (Ann. Chim. Phys. 1851, 32, 142) obtained it in the form of quartz crystals by subjecting a hydrochloric acid solution to a temperature of 200°—300° C. Daubrée (Compt. rend. 1857, 45, 792) obtained it in the form of quartz crystals by decomposing the chloride or fluoride of silicon by steam in an ignited porcelain tube, and also by decomposing glass by water at a high temperature, under pressure. He also alludes to his experiments on the silica which separates in the bead of phosphorus salt before the blowpipe. He then proceeds to describe a very interesting series of experiments in which he succeeded in obtaining crystals of tridymite, the variety of silica discovered by von Rath, which has a peculiar crystalline form and specific gravity. He obtained the tridymite by fusing in a porcelain furnace, (1) adular with phosphorus salt, (2) amorphous silica with phosphorus salt, (3) amorphous silica with carbonate of soda, (4) amorphous silica with wollastonite, (5) amorphous silica with borax, (6) finally, by igniting quartz or amorphous silica. Tridymite occurs in volcanic rocks, also in minerals formed in the wet way, as opal. It is characterized by its occurrence in hexagonal plates, compounded in groups of threes; by a peculiar specific gravity of 2·2 to 2·3; and by its slight solubility in carbonate of soda solution and in hydrate of potassa.

A Treatise on Ore Deposits. By Bernhard von Cotta. Translated from the second German edition by Frederick Prime, Jr., Instructor in Assaying, School of Mines, Columbia College. 8vo, 574 pp. D. Van Nostrand, 23 Murray Street, New York.

Proceedings of the American Pharmaceutical Association at the Seventeenth Annual Meeting, held in Chicago, Ill., September, 1869. 8vo, 468 pp. Philadelphia, 1870.

The Chemical Forces: Heat, Light, Electricity. An Introduction to Chemical Physics, designed for the Use of Academies, Colleges, and Medical Schools. By Thomas Ruggles Pynchon, A.M., Professor of Chemistry and the Natural Sciences, Trinity College, Hartford, Conn. 8vo, 534 pp. O. D. Case & Co., Hartford, 1870.

Annual Report of the State Geologist of New Jersey for 1869. By Prof. George H. Cook. 8vo, 57 pp., numerous maps and sections. Trenton, N.J., 1870.

Address to the American Association for the Advancement of Science. By Benjamin Apthorp Gould, August 20th, 1869. 8vo, 39 pp. Salem: Essex Institute Press, 1869.

Notes on Certain Slates, Felsites, and Elvanites occurring near Knockmahon, in the County of Waterford. By J. Arthur Phillips. 8vo, 6 pp. Extract from the *Phil. Mag.*, Jan., 1870.

Trichina Spiralis. A paper presented to the N.Y. State Medical Society at the Annual Meeting for 1869, by E. R. Hun, M.D. 8vo, 16 pp., and plates. Albany, 1869.

Table Talk. A monthly journal, edited by Charles J. Everett. 4to, 8 pp. 201 Fulton Street, N.Y.

The Technologist. A new monthly journal devoted to Industrial Science. Editors: John Phin and L. F. Olney. Managers: J. H. Caswell, L. H. Mitchell, and Dr. Kempson. Published by the Industrial Publication Co., 176 Broadway, New York.

BREVITIES.

The Lyceum of Natural History.—At the meeting of the chemical section, held Jan. 10th, a paper was read by Mr. O. Loew "*On the Production of Ozone by Flame.*" A discussion on the chemical history of mineral carbon and carbon compounds followed the reading of the paper. At the meeting of Feb. 14th, papers were read by—

Prof. A. M. Edwards, "*On Suggestions for Systematizing Chemical Nomenclature.*"

Dr. A. H. Gallatin, "*On Ammonium.*"

Dr. H. C. Bolton (by title), "*Index to the Literature of Uranium Compounds.*"

Prof. C. A. Seely, "*On Dissociation.*"

Frequency of Poisoning.—Prof. Von Uslar, of Göttingen, recently informed the editor, that during the past fifteen years he had been called upon to make three hundred and four examinations for poison. In eighty-seven cases the bodies were found to contain poison. Four or five of these were proved to be suicides. In three cases the suspected parties defeated justice by killing themselves; and in only two or three cases were the guilty persons executed. The poisons found were arsenic, phosphorus, cyanide of potassium, prussic acid, copper, etc.

The Philadelphia Gas Works.—These works are the property of the city, and are managed by trustees. There are 533 miles of mains, 8,127 street-lamps, and the total number of lights is 801,877. During the year 1869, there were consumed 136,502 tons of coal, and 233,296 bushels of lime, which yielded 1,163,162,000 cubic feet of gas and 4,152,276 bushels of coke.

The American Academy of Arts and Sciences, at Boston, has presented gold and silver medals, together of the intrinsic value of $300, the gift of Count Rumford, for the most important discoveries in this country of useful improvements in the application of heat and light, to Geo. H. Corliss, of Providence, R.I., for his improvement in the steam-engine.

The Manufacture of Salt in Michigan and New York.—The Saginaw region is still the only one entitled to be called the salt district of Michigan.

The first salt operations there were commenced in 1859, a company, called the East Saginaw Manufacturing Company, having been organized, and the first well completed in March 1860. The first salt was made in July, 1860. The following summary shows the amount of salt manufactured each year since the business began:—

	Bbls.		*Bbls.*
1860	4,000	1865	477,200
1861	125,000	1866	407,997
1862	243,000	1867	474,721
1863	466,000	1868	555,690
1864	529,073	1869	577,569

The following table, prepared on November 1, 1869, contains the statistics of the salt business for the year:—

Number of companies in operation	59
Number of blocks	119
Number of kettles	4,178
Number of solar covers	4,304
Number of grainers	128
Number of acres of land covered	9,500
Amount of money invested	$2,432,500
Salt made in 1869, barrels	577,569
Men employed	781
Value of barrels used	$225,026

The following analyses, made by Dr. C. A. Goessmann, Professor of Chemistry at the State Agricultural College of Massachusetts, show the general character of the brines:—

	I. *Portsmouth Well.*	II. *East Saginaw Co.'s Well.*	III. *Bangor Co.'s Well.*
Chloride of sodium	12·53	16·86	19·86
Chloride of magnesium	0·35	0·96	1·26
Chloride of calcium	0·42	2·27	2·96
Sulphate of lime	0·49	0·15	0·07
Total saline matter	13·79	20·24	24·15
Water	86·21	79·76	75·85
	100·00	100·00	100·00
Depth of the well	664 ft.	806 ft.	774 ft.
Temperature of brine	58° F.	62° F.	66° F.
Degree of salometer	54°	80°	95°

It is interesting to notice the relation which exists between the percentage of sulphate of lime and that of the chlorides of magnesium and calcium: as the latter increases the former decreases.

Dr. Goessmann has called attention to the same fact in the mother liquors of the brines at Syracuse, N. Y.

The greater concentration of the Michigan brines is fully offset by their richness in the chlorides of calcium and magnesium. The Syracuse brines are not as strong, but are purer. Dr. Goessmann gives the following analyses:—

	Syracuse.	*Salina.*
Chloride of sodium	15·36	14·94
Chloride of magnesium	0·14	0·13
Chloride of calcium	0·08	0·08
Sulphate of lime	0·57	0·59
Saline matter	16·15	15·74
Water	83·85	84·26
	100·00	100·00

The quantity of salt manufactured on the salt reservation of New York, in the towns of Syracuse, Geddes, Salina, and Liverpool is now about nine million bushels, of 56 lbs., per annum, consisting of "*Solar*," "*Boiled*," and "*Factory-Filled*" salt. The latter is manufactured by a process introduced by Dr. Goessmann, and is the purest salt in our market. It is prepared by grinding the solar or boiled salt, and washing it with a saturated solution of salt, to which a quantity of carbonate of soda has been added, sufficient to decompose the chloride of calcium contained in the salt. It is then drained and dried.

THE CHEMICAL NEWS.
Vol. VI. No. 4. American Reprint.

NOTES FROM THE LABORATORY OF A SUGAR REFINERY.

BY WILLIAM ARNOT, F.C.S.

(Continued from Am. Repr., March, 1870, page 129.)

VIII. Char "Diseases."

The "diseases" to which animal charcoal is subjected are very varied in their nature, and proceed from widely different causes. Upon this subject some very erroneous ideas are entertained by many of our refiners, as well as by scientific men. The manner in which certain specifics have been recommended and employed, with a view to cure almost every variety of "disease," testifies to the truth of the assertion. It is the writer's intention in this note briefly to notice the several diseases which have come under his own observation, and with the cause and cure of which he has had more or less to do.

1. *Deficiency of Carbon.*—This is a very serious defect, and one much more prevalent than might be supposed, considering that, in certain classes of refineries, the carbon increases, rather than diminishes, by continued use. A good working char should contain from 9 to 11 per cent. of carbon; when it falls below 9, some agency is at work which ought at once to be enquired into. Faulty slides or joints will be admitting air to the ignited char in the kilns or coolers; or the system may be such that the char has to pass through the air on its way from the kilns to the coolers; in either case, a portion of the carbon is oxidised, and the proportion consequently reduced. Or the re-burning may be conducted at too high a temperature, a reaction taking place, in consequence, between the carbon and water—the latter being decomposed, and compounds of the former formed; or, further, deficiency of carbon may arise from the use of sugars containing large proportions of sulphates and sulphites, as indicated in Note III. The cause discovered, the cure is simple—have the kilns repaired, or renewed; re-burn at a more moderate temperature; avoid the use of sugars impregnated with sulphates and sulphites. Of course, attention to these points cannot restore the carbon already gone, but will prevent a further reduction of this valuable agent; the carbon may, indeed, increase, but it is questionable whether the increase will improve the quality of the char. The want of carbon is one of the worst diseases incident to animal charcoal—the reduction of that agent from 9 or 10 per cent to 6 or 7 means a reduction in decolourative power very much greater than these figures indicate; the preservation of the carbon ought, therefore, to be a special study of the refiner. The writer has before him at the present moment a sample of char from a working stock of several hundred tons, containing under 5 per cent of carbon; how a refinery with such a char stock can yield a profit to the refiner is more than he can guess.

2. *Excess of Carbon.*—As already indicated, the carbon usually increases by continued use; in some refineries, this increase is rapid and great, so great, indeed, as to amount to a "disease." This disease may arise from defective washing, or from the use of water containing considerable quantities of vegetable matter. The deposit of carbon, by the decomposition of organic matter in the process of re-burning, clogs up the pores of the char, just as any other impurity does; its injurious action ends there, however, having no active deleterious action in itself, as some other impurities have.

3. *Oxide of Iron.*—The presence of this agent in any considerable quantity may well be considered a "disease": it is most injurious and potent in its action. The faintest trace of iron in the refined product at once manifests itself on the addition of tannic acid or tea; and so injurious to the commercial value of the sugar is the presence of even the minutest quantity of that agent, that its avoidance is worth any expenditure of care and cash on the part of the refiner. Iron may accumulate in char from various causes—in the process of re-burning there is, no doubt, a slight and unavoidable increase, but, with care, this need not be serious; if, however, defective kilns and careless manipulators are employed, this may prove a very fruitful source of iron. Here, therefore, is another inducement to the refiner to attend to the careful maintenance of his re-burning apparatus. But a more general source of iron is to be found in the action of sour or acid "washings," "scum-waters," &c., upon unpainted or defectively painted cisterns, moulds, &c. These "washings" impregnated with iron are used in dissolving raw sugars, or are concentrated and run through fresh char; a portion of the iron is extracted by the char and is ready to be given up to the first acid liquor that follows. There is thus a constant addition and abstraction of iron, which becomes about equal when about 0·7 per cent of oxide has been incorporated with the char. A thorough system of painting, with the avoidance of acid liquors, waters, &c., as far as practicable, is recommended. A portion of the iron may be removed from char suffering from this disease by the use of dilute hydric chloride and some other agents; but, as this subject will be treated of in a separate note, it need not be the subject of further remark here.

4. *Lime.*—Accumulations of this agent in the pores of the char reduces the potency of the char as a decolouriser, and may otherwise injuriously affect the sugar liquors passing through it. This is not a disease very common in this country—at least, not to any serious extent. Several refiners, fancying their char was loaded with this agent, have expended large sums upon curative processes, but generally to no purpose, as the lime was more usually found to be deficient than excessive. Beanes's most admirable process for the removal of lime from char has, to a certain extent, failed in this country,—not from any defect in the process, but from a want of the material to operate upon. A more ingenious and trustworthy process *for the removal of excess of lime* could not well be devised; and, on the Continent, where lime rapidly accumulates in the char in the process of refining "beet," the patent process would yield most excellent results. The writer has, on more than one occasion, had cause to feel surprise at statements made about Mr. Beanes's system, especially by chemists. It was defective because you could not wash the char free from acid; could not regulate the supply of gas to the requirements of the char; and other statements have been made, which simply show that the process was never understood by the parties making them. The process is free from all such objections, and, where lime exists in such excessive proportion as to render its removal desirable, no fear need be entertained with regard to the application.

5. *Overburned Char.*—Char that has been repeatedly overburned contracts—shrivels up, so to speak; the

[English Edition, Vol. XXI., No. 532, page 49.]

pores become smaller, or cease to exist. This is a serious defect, and one which cannot be remedied.

6. *Glazed Char.*—The glazing of char has been attributed to several causes by different writers; but the author, although he has given some attention to the subject, is by no means satisfied as to the real cause or causes. Friction may have something to do with it; but this is not the initial cause: defective washing will be more likely to account for it. That glazing is injurious to the char is beyond question; when chars become very highly glazed, their decolourative power is more or less reduced.

7. It is only necessary to indicate that two or more of the above diseases may obtain at the same time, and that complication of diseases renders successful treatment very difficult of attainment.

IX. Char Treatment.

When a refiner discovers his char stock to be in a "diseased" condition, he naturally begins to look about for some method of treatment, by the adoption of which the quality of his char may be improved. The search is usually made in a hap-hazard way; no very definite notion of what the disease really is which affects his char having been obtained, a process for the removal of iron or lime may be adopted when the real source of the inefficiency of the char may be excess or deficiency of carbon, or such like. The first step which ought to be taken when a char ceases to give satisfactory results is to have it carefully analyzed; but this will be of comparatively little use if analyses have not been formerly made. A regular monthly or bi-monthly analysis of every refining stock should be made, and the results of each compared with those preceding; the refiner will thus be able to trace the nature and progress of disease in his char, if any exists. If suspicion is thus aroused that all is not right, more frequent analyses should be made, and, at the same time, some well-considered system of treatment adopted. It may be well to draw attention here to the obvious necessity for such analyses being made with rigorous care. An increase or decrease of carbon from week to week or from month to month of 0·5 per cent, increase or reduction of calcic carbonate to the same extent, or an increase of iron to the extent of 0·1 per cent of oxide, are most important indications, and ought to receive the special attention of both analyst and refiner.

A fair idea of the nature of the defect having been obtained, the mode of treatment most likely to improve the char must be carefully considered. It will very frequently be found that the safest, most efficient, and, in the end, least expensive course to follow will be to increase the washing; to use the washing water boiling, instead of simply "warm"; to see to the kilns and coolers being tight, and the working of them specially attended to; to reject suspicious sugars; and generally to give greater attention to the employment of careful and efficient workmen. The writer has more faith in measures such as these, than in the hasty adoption of special systems of treatment, which often lead to mischievous results. But, in the face of every precaution, "diseases" do creep in sometimes, and the adoption of some special measures may be imperative; but, whatever the system to be adopted, numerous and frequent, carefully-conducted, small-scale experiments should first be made. The diseases open to special treatment are, as indicated in the preceding note, principally excess of lime and iron. For the removal of these, the following processes have been adopted with more or less success.

1. *Fermentation* of various kinds and degrees. The char may be left in the cisterns with a little "sweet" remaining in it (*i.e.*, without being thoroughly washed) for some days, during which time a brisk action will take place: the traces of sugar, as well as the several organic impurities left in the char, are decomposed, with formations of various weak acids, which combine with the lime, forming salts easily removable by washing. Or a quantity of "sour water" may be run upon the char, and allowed to stand as before; the action will be the same, slightly intensified. Many modifications of this system are in use, the action in all cases being the same in kind, differing only in degree. Crude acetic acid and churned milk have also been used to promote and intensify acetic and lactic fermentations.

Fermentation is a simple and cheap mode of treatment, but the results, although generally in the right direction, are not usually very great. The amount of acid produced is comparatively trifling, and has seldom any action upon the iron, enough lime being generally present to saturate the acid as produced. It has its harmlessness to recommend it; but it keeps the char an objectionably long time out of use, and, moreover, monopolises the char cisterns to a serious extent. This latter objection may be got over by adopting a system of "dry fermentation," in which the char, well drained, but moist, and containing the fermenting agents already referred to, is removed from the cisterns, and allowed to lie in a heap for a week or two, or until all action has ceased. This process, however, involves a large amount of additional labor, and, as in the other case, keeps the char out of use longer than desirable.

2. *Dilute Hydric Chloride* has been used, in various ways and in all degrees of strength; and, for the removal of iron, perhaps no better agent can be employed. Sodic sulphite has been recommended to be used, along with hydric chloride, for the removal of iron; but the writer has not found the results of such treatment at all satisfactory. Hydric chloride must at all times be used with extreme caution; very dilute solutions should always be preferred, though the amount of lime or iron removed should be the smaller. The effects of any acid treatment is never perfectly satisfactory: the amount of impurity removed is generally less than anticipated; danger of injuring the structure of the char always exists; in whatever way the acid is applied, some of the char is certain to get more than its share, another portion getting less; while the entire removal of the acid from the char, after it has done its work, is difficult, if not impossible. Char, after having been treated with acid, washed, and re-burned, always shows an acid reaction—so difficult is the acid to wash out; and this residual acid has the effect of misleading the refiner when his sugar-liquor passes through the char for the first time. The liquor will look unusually bright, and light in colour; but colour due to the presence of traces of acid is valueless, as, in the process of boiling, it entirely disappears. Dr. Wallace, in his lecture to the Chemical Society, indicates that the colour of the sugar produced in such circumstances is superior, though the syrups are increased in quantity. This the author has not found to be the case; the syrups are increased, but the colour of the sugar is not improved.

3. *Gaseous Hydric Chloride.*—Mr. Beane's process has already been referred to (Note VIII.). When the circumstances which obtain are such as to warrant its use, great care must be taken to have apparatus of the

best construction, and thoroughly trained workmen to attend to the various operations involved. When the excess of lime has been removed, the process will, of course, be stopped until, by a sufficient increase of that impurity, it can again be used with safety and with profit. Dry gaseous hydric chloride has no action upon the iron; so that, for the removal of that powerfully-injurious agent, it is inapplicable.

Various other acids have been used with a view to improve the quality of animal charcoal, but (unless in very special cases) with very discouraging results. Even carbonic acid has been used, forced into the char in the gaseous form under high pressure, under the impression that the calcic carbonate would be changed into bicarbonate, and thus rendered soluble. This may serve as an illustration of a rather numerous class of "inventions," the results of which are not only valueless, but, in some cases, most injurious. A case has come under the writer's notice, almost too absurd to be mentioned, in which undilute oil of vitriol was poured direct from the carboys upon the char in the cisterns. After the mixture had been allowed to act *a sufficient length of time*, it was dug out in blocks with picks! This process was conducted under chemical supervision!

The preservation of char in a state of efficiency is perhaps the most important problem in the sugar-refining industry; and certainly it were much better for the refiner to devote his best energies to the retention of his char in good condition, than to be compelled to adopt expensive, troublesome, and often questionable processes, with a view to restore qualities which, through careless working, have been lost. The question of char treatment is a most troublesome one; and, although almost every likely process has been practically tried, both on the large and small scale, by the author, the results have never given him unalloyed satisfaction. He is, therefore, the more desirous of impressing upon refiners the desirability of caring well for good char when they have got it.

A favourite "cure" for faulty char with some, is to mix in new or faultless char in various proportions; but, as must be self-evident to any one who will carefully look at the subject, this is only to disguise the weakness of the old by the potency of the new. A char having a higher average quality will doubtless be the result of such admixture; but it is a mistake to suppose that the faulty char will thus be cured.

St. Anne's Laboratory, Lasswade, N.B.,
January, 1870.

ON THE TECHNICAL ANALYSIS OF SOAP.*

BY M. GASTON TISSANDIER.

The name of soap is given to true salts formed by combining fatty acids (oleic, margaric) with alkalies, such as soda or potash. The quality of a soap is ascertained by determining the proportion of fatty acid and alkali which it contains, and also the foreign substances—such as chlorides, alkaline sulphates, moisture, &c.—which always occur in varying proportions.

Fatty Acids.—Dissolve 5 grms. of the soap in question in ½ a litre of distilled water heated in a porcelain capsule; when dissolved, add a slight excess of dilute sulphuric acid, and let it boil for some minutes, so that the fatty acids may become separated and float upon the liquid. To weigh the fatty acids, cool them, and they will form a cake of grease, which must then be fused, in order to dry them, in a small tared porcelain capsule; this capsule, when again weighed, will give the amount of fatty acids corresponding to 5 grms. of soap.

Wax may also be used to facilitate the weighing. After the first part of the operation has been performed, and the fatty acids are floating, add 7 grms. of white wax, which will melt and mingle with them; cool the whole, take out the cake of wax, and weigh it, previously drying it between double filtering papers. The excess of weight gives the proportion of fatty acids.

Ash,—Soda.—Calcine, at red heat, 5 grms. of soap in a platinum capsule. Weigh the ash thus obtained, and dissolve it in 200 c.c. of distilled water; determine the proportion of soda in 100 c.c. by means of normal sulphuric acid (alkalimetric standard), evaporate to dryness, and notice the action of bichloride of platinum upon the residue dissolved in water, to ascertain whether it consists of potash or soda. The estimation of the soda may be verified by directly taking the alkalimetric standard of the soap (5 grs.).

Chloride of Sodium.—Estimate the chlorine in 50 c.c. of the solution with the standard silver solution.

Sulphate of Soda.—The sulphuric acid is estimated in the remaining 50 c.c. of the solution with chloride of barium.

Non-Saponified Fatty Bodies.—These also occur in soap, and may be detected as follows:—Dry 5 grms. of soap at 110°, after which treat it with common ether. Agitate it with that liquid in a flask, filter it, wash with ether, and evaporate the solution at 100°; the residue will be the non-saponified fatty bodies. The ether may, perhaps, dissolve a little of the soap; it must, therefore, be ascertained that the residue is really fat—melt it, and try whether it will soil glazed paper.

Non-Saponified Carbonate of Soda.—Cut 5 grms. of soap into small fragments, and treat them with boiling alcohol, which does not dissolve carbonate of soda. Filter, and treat the insoluble residue with alcoholic acetic acid, which dissolves the carbonate of soda without acting on the sulphate of soda and chloride of sodium. The acetic solution, evaporated to dryness and calcined, leaves, as a residue, carbonate of soda. Weigh it, and, if verification be required, take its alkalimetric standard.

Glycerine.—Dissolve 5 grms. of soap in boiling water, decompose it with dilute sulphuric acid, and separate the isolated fatty acids by decantation. The liquid, which is completely neutralised by the carbonate of soda, is now evaporated to dryness over a water-bath at 100° C.; the residue, composed of sulphate of soda and glycerine, is taken up by alcolol, which dissolves only the latter; it is then filtered and evaporated to dryness, when the residue will be glycerine. This is again taken up by alcohol, re-evaporated, and the residue again weighed, after ascertaining that it possesses all the properties of glycerine.

Water.—Cut the soap into thin slices; weigh 5 grms., and dry them on a stove at 120° C.

Composition of Various Kinds of Soap.

Substances estimated.	I.	II	III.	IV.
Water	46·12	24·76	17·55	14·09
Soda	4·98	7·30	8·48	9·01
Fatty acids	37·99	64·50	71·45	74·68
Chloride of sodium	6·30	3·12	2·12	2·00
Sulphate of soda	0·72	0·32	0·40	0·22
Fatty bodies	1·00	—	—	—
Glycerine	2·89	—	—	—
Total	100·00	100·00	100·00	100·00

* *Moniteur Scientifique.*

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Amer. Repr., March, 1870, page 140).

The subject of drawing materials is of some little importance, and, as it is not treated upon in any microscopical work, a few remarks may not be out of place.

Probably no material is capable of representing elaborate microscopical subjects with so much truth as *water-colour*. When used with all the appliances of the modern school of painting, both colour and texture can be very closely imitated by skilful artists; but few have turned their attention to this subject; and, as the process is costly and not easy to acquire without a considerable amount of study, the use of this mode of representation will, in all probability, be very limited. Those who possess the requisite skill are strongly recommended to make use of it. Even as pictures, groups of aquatic animals and plants are quite as beautiful, both in form and colour, as flower compositions; and no other means of delineation, excepting the still more difficult art of oil-painting, can approach the truth of a highly-finished water-colour drawing. Unfortunately, at present, no means exist of re-producing these beautiful pictures, as their extreme delicacy places them beyond the powers of chromo-lithography.

The effect of outline sketches is much improved by the judicious employment of tints of water-colour; and this is by no means a difficult process, as it is a mere matter of laying on colour; while, in painting proper, quite as much is done by taking off paint as by putting it on, and also every advantange taken of the texture of both paper and pigment.

Pencil drawing is particularly useful for microscopical purposes. Fine lines can readily be made, and the shading is capable of much refinement, so that very delicate tissues can be faithfully delineated. Unless the drawing consists entirely of fine lines without shaded tints, the use of hot-pressed or perfectly smooth paper is not to be recommended, but one having a small, fine grain is to be preferred. The paper should always be supported behind on some hard substance, otherwise the pencil-point will cut in, the line be difficult to rub out, and also much of the power of guiding the pencil lost. For delicate drawings, a piece of thick plate-glass makes an admirable drawing-board. The blocks or solid sketch-books so much used in out-door sketching when made of a suitable paper, are particularly pleasant and convenient to draw upon. For shading, the pencil should not be cut to a sharp point, but rather kept square. Those with extra thick leads (such as BBBB and EHB) may sometimes be used to advantage, and even the broad, flat crayons known as Harding's tablets. For general outlining with camera or ruled disc, HB, from its freedom, will be found useful. For a fine outline, H should be used. Delicate tints may be obtained by rubbing on black-lead powder with a leather stump; the most convenient is that known as "Harding's." The author has found no black-lead pencils equal to those made by Mr. B. S. Cohen; they are very even in texture, rub out easily, do not readily break, and correspond exactly with their respective marks. The 6 H, made for drawing on wood for engraving, is well adapted for the purpose for which it is intended.

Pencil drawings, and also those in chalk and charcoal, may be permanently fixed by applying freely at the back until the paper is saturated a varnish composed of white (bleached) shellac, made by mixing equal parts of white lac-varnish and methylated spirit. The white lac-varnish is always supplied by Messrs. Winsor and Newton of uniform strength, and will save the trouble and difficulty of dissolving bleached lac. The drawing is to be carefully dried before a fire, and, when completed, may be rubbed with india-rubber with perfect impunity. Water-colour may be freely used in combination with pencil, as it is not affected by this varnish, which does not stain the paper when dry, although it soaks in when first applied, and renders it transparent like oil.

The multiplication of microscopical drawings is a subject worthy of the attention of every observer. With the exception of Dr. Beale,* no writer on the microscope has given any account of the various processes of engraving; and yet, unless the microscopist can command the services of the very few engravers and lithographic artists who have devoted themselves to the re-production of microscopical subjects, there is, as the author has found by experience, great risk of misinterpretation.

Photography is capable of copying drawings with great exactness, and has no fault saving its cost. When only a small number are required, it would probably, however, be cheaper than any of the printing processes.

The printing processes proper consist of plate and surface printing and lithography.

Copper and steel plate engraving consists of cutting lines in a metal plate with a pointed steel tool of square or rhomboidal section, known as a graver. The plate, when finished, is rubbed over with a thick printing-ink, which is afterwards cleaned off, leaving the lines full (Fig. 45 B, 1). The plate is then passed through a powerful rolling-press with a sheet of thick, porous paper over it, which is forced into the lines, and takes the ink out of them, forming the impression (Fig. 45 B, 2). Instead of excavating the lines with a cutting tool, the plate may be covered with a preparation capable of resisting acids, known as etching-ground. The copper is then laid bare by scratching through the ground with a suitably-mounted needle. Diluted nitric acid is poured on the plate, and allowed to corrode the metal. When sufficient depth is obtained, the acid is poured off. Those lines which are "bitten" sufficiently are filled up with varnish. The process of biting is then repeated until the deepest lines are sufficiently corroded. This process of *etching* is a great favourite with artists, and might, no doubt, be turned to account for microscopical purposes, as it is much easier than using the graver, which is a very troublesome tool. The disadvantage of plate printing is that the obtaining of impressions is expensive, and the number limited, owing to the rapid wear of the plate; this latter objection, however, may be overcome by copying the plate by electrotype. The variety of engraving known as mezzo-tint is well adapted for the representation of tissues; but it requires a skilled engraver, and the learning of it would take up too much of the observer's time.

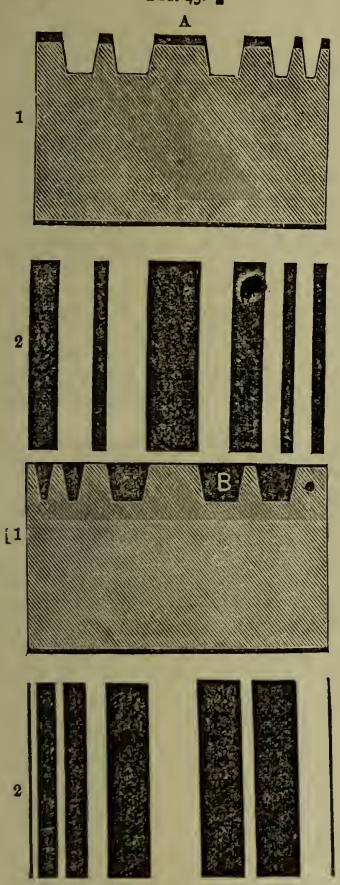
Surface printing is the reverse of plate printing. In this, as will be seen (Fig. 45 A, 1), the light parts are excavated and the dark parts left standing; these receive the ink from the roller, and yield a copy to a sheet

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869.

* "How to Work with the Microscope," pp. 28—35.

of paper upon pressure being applied (Fig. 45 A, 2). Common type is an example of this kind of printing. For art purposes, wood-engraving is employed. The drawing is made on a block of box-wood, which is then

Fig. 45.*



placed in the hands of the engraver, who cuts away the light portions, leaving the solid black (if any) standing, and variously modifying, by lines and dots, the portions which have a tone between black and white "half-tints." The process is a difficult one, requiring great skill, which is only to be acquired by very long practice. It is capable of rendering microscopical subjects with great perfection: the re-productions of Dr. Beale's drawings in his various papers, by Miss Powell, are marvels of delicacy. Some beautiful specimens of wood-engraving will also be found in the work on the microscope by the late Richard Beck. Wood-engraving has the advantage of being cheaply printed, and also of being set up along with type, although, in the latter case, its beauty is somewhat sacrificed: it never has justice done to it unless it is printed by itself, and with very great care. A valuable little book on the "Art of Wood-Engraving," by T. Gilks, is published by Messrs. Winsor and Newton.

A very ingenious printing process, known as *graphotype*, has been lately brought forward. In this, a quantity of finely-powdered chalk is compressed into a solid tablet; this is drawn upon with a fine brush charged with an ink which hardens the chalk wherever it touches. The drawing is then sent to the patentees, who brush away the chalk, leaving the lines standing. A mould is made in plaster of Paris, from which a cast in type-metal, capable of yielding impressions in the common printing-press, is taken. Every facility is afforded by the Graphotyping Company, No. 7, Garrick Street, W.C., to persons wishing to test the merits of the process.

Lithography printing remarkably from all the processes of multiplying impressions just described. While, in plate and surface printing, it was essential that there should be a difference of level between the parts intended to print light and dark, in the various lithographic processes, light and dark are all printed from the same surface. The operation is purely a chemical one, and depends upon the mutual repulsion of oil and water. The stone used is a fine-grained and very compact limestone, capable of bearing a high polish, principally supplied from quarries at Solenhofen; and it would seem that it was destined to transmit natural history information to posterity, as many of the slabs enclose fossil-insects, as perfectly preserved as if they had been shut up between the leaves of a book for a few weeks, instead of ages. The British Museum has a very large collection of these specimens of Nature's lithographs. If a grease-mark be made upon the smooth surface of this or similar stone, and it then be wetted, it will be found, upon passing a roller charged with printing-ink over the stone, that the ink will adhere to the greasy portions, while it will be repelled by the parts that are wet. If the stone, with a sheet of paper on it, be passed under the press, an impression will be obtained; and, by a series of wettings and inkings, the operation may be repeated any number of times. This is the foundation of all the lithographic processes, which are numerous, and suited to the production of a great variety of effects, mostly by the use of means differing less from the ordinary manipulations of the artist than any of the other means of multiplying drawings. The use of grease or oil as a material for drawing upon stone is open to many practical objections; therefore, a greasy material is manufactured, more closely resembling, in form, that used in the ordinary process of drawing. It is composed of a mixture of tallow, soap, wax, and shellac, with a portion of lamp-black, to give it sufficient colour to guide the artist in making his drawing. The proportions vary according to the purpose for which it is required, and the combination of the materials is a matter of very nice manipulation. It can be procured, properly prepared, of the dealers in lithographic materials, and will be found in the form of crayons of three degrees of hardness, which are used like ordinary artists' chalks, and cakes, which are soluble in water, and can be rubbed down like Indian-ink, care being taken to use distilled or very pure water, otherwise, from the soapy nature of the ink, it will not mix freely.

In making drawings with the ink, a fine brush or suitable steel pen may be used; and, if the drawing is to consist entirely of ink-work, a polished stone should be employed. Care should be taken not to touch the stone with the fingers, as every greasy mark, although invisible when made, will print when the stone is rolled in. If the crayons, or chalk, are used, the stone should be what is called "grained," that is, its surface should be prepared with a texture somewhat like that of drawing-paper, to enable the chalk to be rubbed off the crayon and held by the stone. The fineness or

* We are indebted for this woodcut to Messrs. Winsor and Newton.

coarseness of the grain must be suited to the nature of the drawing: microscopical drawings usually require a very fine grain. The manipulation is somewhat like that of pencil and chalk drawing on paper, only taking certain precautions rendered necessary by the nature of the material. All light tints should appear darker on the stone than they are intended to print, as they lose some of their strength in the preparation which the stone undergoes before it is printed from. Dark tints should be worked up gradually, by repeating the touch of the chalk in as many directions as possible, so that the minute papillæ, or roughnesses, which form the grain of the stone may be loaded with the chalk on all sides, and consequently suffer less in the etching process. Any attempt to produce a dark tint or spot by a vigorous and sudden touch, as in pencil drawing, will generally fail when the stone is printed. Ink outline may often be used with great advantage in combination with chalk shading. In this case, the outline should be put on the stone with the ink first, and the shading done afterwards, as it is difficult to see the ink outline when the stone is covered with shading, and the chalk is also likely to hinder the adhesion of the ink to the stone. Care should be taken that the work is perfect before it is sent to the printer, as but little or no alteration can be made after the proof is taken. This is one of the greatest defects of lithography, and is unlike copper-plate, where the artist goes on improving and re-touching, after a series of proofs, until perfection is attained. When the printer receives the stone, he washes it with very dilute nitric acid, which converts the soapy ink into grease, and prevents its being washed off in subsequent processes. The stone is then covered with gum-water, which adheres to the parts not touched with ink, and prepares the stone to receive the wet. Then, by a series of spongings with water and rollings with printing-ink, the stone is made ready to yield a very large number of impressions. With a little perseverance and the assistance so kindly afforded by most lithographic printers,* any person who can draw may hope, after a time, to reproduce his works upon stone with tolerable success.

Another process, capable of producing very delicate results, and well suited for microscopical purposes, is that known as engraving on stone. It is by this mode that most of the beautiful works of Mr. Tuffen West are executed. It consists in scratching the lines and dots forming the picture with a diamond-point on a highly polished stone, of which the surface has been slightly coloured, to render the marks visible. Care should be taken not to cut deeply, but only slightly to scratch the stone. The printer rubs the engraved stone with grease, which adheres to the scratches, which, when the stone is rolled in, print as black lines. This process requires much more practice than either chalk or ink drawing; but its results, when well executed, almost rival fine steel-engraving.

White-line lithography, on a black ground, is useful for representing many tissues. It is executed on a polished stone, which is prepared by the surface being covered either with a coat of lithographic ink or grease and lamp-black. The artist, with a diamond point, cuts through the black ground, taking care to lay bare and slightly incise the stone. The diamond is a very free-working tool, and obeys the hand beautifully after a little practice. This process is remarkably easy and expeditious, and is worthy of having its powers developed. Very little use has been made of it at present. It seems capable of great delicacy; and, as so many microscopical observations are made on a black ground, either with the parabola or by reflected light, this process seems to be one very well suited to the wants of the microscopist. As a compensation for the ease of execution, it would seem that black-ground lithographs entail some trouble on the printer, as the fine lines are apt to fill up; but as this kind of printing becomes more frequent in use, doubtless the difficulty will be thought much less of. The author strongly recommends microscopists who have drawings to publish, and who cannot afford the cost of professional assistance, to master some one or other of the lithographic processes. Their work will doubtless, even after some practice, be rough, and not equal to the productions of experienced lithographic artists; but it will have an advantage which is possessed by no copy of a drawing, however good: it will be an autograph, reproducing all the author's peculiarities of style, and preserving those points which are very often lost in the copying of drawings by those who are not familiar with the subjects represented.

The student who wishes to render the microscope really valuable to him must determine, after mastering the technical difficulties of his instrument, to apply himself diligently to the study of some particular subject. One of our greatest authorities (Dr. Carpenter) speaks of "microscope power running to waste" in this country. Another author says:—"We have the best microscopes in the world, and the fewest observations." And it is to be feared that there is much truth in these statements. The microscope is, in the hands of many persons, only a costly toy. It should be regarded rather as a tool, and the naturalist's most efficient one. The work of the microscope does not consist in resolving the striæ of difficult diatoms; this has been done over and over again, and yet we seem to be not much nearer the truth than before. However, if we cannot understand the markings of the diatoms, they have done us service: they have caused our instruments to be continually improved, till now it is doubtful whether much more advance can be made.

The beginner is strongly recommended to go carefully through the tables at the end of Dr. Beale's "How to Work with the Microscope," carrying out the principles there laid down; for, though the work is principally written for students of anatomy and physiology, it may be consulted by all enquirers with great benefit. Great progress may always be made if the student has the good fortune to be acquainted with some working microscopist. Many such are glad of the assistance of others; and, although the beginner may not be able to originate an enquiry, he may confirm and verify the observations of others, and, in so doing, add largely to his own stock of knowledge.

The numerous microscopical societies in London and elsewhere offer great facilities to the young student, by giving him opportunities of becoming acquainted with the best practical microscopists. Many of the societies have regularly organised collecting-excursions, under the direction of experienced persons. By attending these meetings much information may be gained.

The recent application of the spectroscope to microscopical research will no doubt be a very promising field of enquiry. Already, besides other discoveries, the distinction between two vegetable reds (those of the

* The author has been much indebted to the artists in the office of Mr. West, Hatton Garden, for much valuable information.

grape and elder-berry) has been pointed out by its means, and will probably lead to the detection of methods of adulteration which have hitherto baffled both chemists and microscopists; and many more very important results may be expected to be elicited by steady application and careful use of this most delicate means of distinguishing colour. The use of the microscope is far from being confined to those sciences which are connected with natural history. The instrument has been applied, with the greatest advantage, to researches on inorganic matter; and much valuable information has been obtained by the observations of Mr. Sorby and others who have devoted themselves to such enquiries.

ON THE

ACTION OF BROMINE UPON ETHYLBENZOL.*

BY T. E. THORPE, PH.D.

In the course of an investigation upon ethylbenzoic acid, which Professor Kekulé and the author recently published, they had occasion to prepare a quantity of monobromethylbenzol, $C_6H_4Br\{C_2H_5$, the object being to prove, experimentally, the identity of the ethylbenzoic acid made synthetically by acting upon monobromethylbenzol by means of carbonic anhydride and sodium with the acid subsequently obtained by Fittig by oxidising diethylbenzol by means of nitric acid. The authors, while preparing the bromide they required for their experiments, followed the directions given by MM. Fittig and König. The action of bromine upon ethylbenzol is very energetic, and the last-named substance has to be strongly cooled. The resulting product was submitted to fractional distillation; at 145° the liquid commenced to boil, and a comparatively large quantity passed over between 150° and 160°; but the greater portion came over between 180° and 190°. An analysis of that portion showed it to contain very nearly the theoretical amount of bromine calculated for C_8H_9Br; this compound is very unstable. On renewed distillation, it was found to begin to boil at 140°, and, unless the distillation is very rapidly conducted, a large proportion is transformed into styrol and hydrobromic acid; this difficulty is met, however, by distillation *in vacuo*. The bromide thus obtained is a heavy colourless liquid, boiling nearly constantly at 148° to 152°, and possessing a characteristic penetrating odour. When heated with solutions of ammonia or potassa in alcohol, it gives up its bromine with the greatest facility. The author points out the very great difference of properties discovered by him to exist between the monobromethylbenzol described by M. Fittig and that obtained by him and just alluded to, and reasonably concludes that these substances, although prepared under conditions apparently exactly similar, are not identical. The compound obtained by the author is identical with that obtained by Berthelot by acting upon boiling ethylbenzol with vapours of bromine, and the formula of that substance is $C_6H_5\{C_2H_4Br$.

The larger portion of the contents of this paper is further devoted to the description of the experiments made to discover the cause of the variation in the position of the bromine atom. As the result of these experiments, some new substances were obtained; among these, styrolylethyl-ether, a colourless, mobile, fragrant-smelling liquid, boiling constantly at 187° (sp. gr. at 21·9°, 0·931), slightly soluble in water, and burning with a strongly-luminous flame.

The author describes, at great length, the different operations and manipulations applied by him, but space forbids us to enter into more details on this subject.

* Abstract of a paper communicated to the Royal Society.

ON THE

SUPPOSED NUCLEATE ACTION OF WEAK SOLUTIONS OF GLAUBER'S SALT

ON

SUPERSATURATED SOLUTIONS.

BY CHARLES TOMLINSON, F.R.S.

A gentleman, under the signature of "A Constant Reader of the Chemical News," has written to me respecting my theory of the action of nuclei on supersaturated solutions,* and states that this theory does not meet the case given by M. Jeannel,† in which a supersaturated solution (say of Glauber's salt) filtered into a flask, is protected by leaving the funnel and the filter in the neck of the flask; so that when cold, an ordinary solution of the same salt being poured upon the filter, produces crystallisation as soon as it reaches the supersaturated solution.

The objection is—(1) that, in such a case as this, there can be no nucleus derived from the air, and (2) that the liquid which causes the solution to crystallise is chemically clean.

While engaged in studying the subject of supersaturated solutions, I read M. Jeannel's paper with much interest, and repeated his experiments with such variations as the nature of the case seemed to require. My conclusion was that, if the experiment be conducted with proper attention to cleanliness, and care to exclude nuclei, a solution of Glauber's salt may be allowed to fall upon a cold supersaturated solution of the same salt without inducing crystallisation.

So long as I adopted M. Jeannel's form of experiment, I always obtained his result—namely, a separation of the salt from the supersaturated solution. But this form is objectionable, because, by leaving the funnel and filter exposed during many hours to the air, active nuclei become accumulated on it, and some of them are sure to be dragged down with the solution into contact with the contents of the flask. In like manner, a crystal taken up between the finger and thumb, or even by mere exposure to the air, is said to be an active nucleus in crystallising a supersaturated saline solution of its own kind; but I have already proved‡ that, if care be taken to make the crystal chemically clean, it is possible to bring it into contact with a highly-supersaturated solution, and to leave it there for days, and even months, without any separation of the salt.

M. Jeannel's position is that drops of a solution of a salt, allowed to fall upon a supersaturated solution of the same salt, will cause it to crystallise. In testing such a proposition, I am, of course, allowed to adopt my own means for conveying the drops to the solution, and, provided they reach it and fall upon it, the case is met, even though the funnel and filter be dispensed with.

My method of conducting the experiment was this:—A solution of Glauber's salt was filtered into a clean

* Chemical News, vol. xix., p. 267; *Am. Repr. Aug.* 1869, *page* 69.
† *Ann. de Ch. et de Ph.*, 4 Ser., t. vi., p. 166.
‡ Chemical News, vol. xviii., p. 110; *Am. Repr. Nov.* 1868, *page* 231.

flask, in which it was boiled up again; and, while boiling, a clean, straight dropping-tube, closed by means of a cork at the top, and passing through a disc of vulcanised india-rubber, was put into the flask, so that its point dipped below the surface of the solution. The heat expanded the air of the tube, and a considerable quantity of it escaped in bubbles. When the lamp was removed, an equal volume of the solution entered the tube, which was then pulled up about an inch, so as to be out of, but over, the solution. The india-rubber disc protected the solution from the entrance of nuclei, but, as a further precaution, each flask was covered with a bell-glass. In this way, the solutions can be kept as long as may be required without crystallising. On taking off the bell-glass and gently loosening the cork (a stop-cock would have been better), the solution fell from the tube in drops, but there was no separation of salt.

Two solutions were next made, the one containing 1 part of salt to 1 of water, and the other 2 parts of salt to 1 of water. Each flask contained a tube, passing through an india-rubber disc, as before; and, when the tubes had taken up a quantity of the solution, they were changed—that is, the tube containing 1 salt to 1 water was put into the flask containing 2 salt to 1 water, and *vice versâ*. When the solutions were cold, the corks were loosened. The drops produced much disturbance in the internal viscosity of the solutions, but there was no crystallisation.

In another experiment, the solution containing 1 salt to 1 water was allowed to drop into a solution containing 3 salt to 1 water, and this into the solution of 1 salt to 1 water. The solutions were prepared over night, and, as the night was cold, the flasks, as well as the tubes, contained portions of the modified salt, so that crystals as well as drops fell into the solutions; but still the solutions did not crystallise: on taking out the tubes, they did so immediately, the nuclei being, of course, derived directly from the air.

A still weaker solution (namely, 1 salt to 3 water) was allowed to drop into a supersaturated solution containing 2 salt to 1 water; but there was no separation of salt.

Hence it will be seen that, if proper precautions be taken to exclude nuclei, a solution of Glauber's salt does not act as a nucleus to a supersaturated solution of the same salt.

Supersaturated solutions of potash-alum, treated in the same way, lead to the same result. I have no doubt that similar solutions of other salts would lead to the general conclusion that solutions of salts do not act as nuclei to their supersaturated solutions.

Highgate, N., Jan. 29th, 1870.

ON THE DECOMPOSITION OF SALTS OF SESQUIOXIDE OF IRON.

BY M. H. DEBRAY.

If a solution of neutral chloride of sesquioxide of iron, so much diluted that its colour is scarcely perceptible, be heated, the liquid will be seen, after arriving at 27°, to become strongly coloured and assume the characteristic hue of sesquioxide of iron. This change is not owing to the evolution of a certain quantity of chlorhydric acid, for it is effected in close vessels, and, after cooling, the liquid retains its primitive acid reaction and the colour which it has received from the heat.

The chemical properties of the salt of iron are greatly modified: the original liquid gives with yellow cyanide a precipitate of a deep Prussian blue colour, whilst the coloured solution with the same reagent yields only a pale greenish blue precipitate, and saline solutions of sea-salt for instance, without acting on the ordinary chloride, produce in the modified chloride a gelatinous precipitate of hydrated sesquioxide of iron. This oxide, when immediately washed, re-dissolves in the water and contains only small quantities of salt, but it loses the property of solubility if it be allowed to digest a day or two with its precipitant. The modified solution when dialysed gives chlorhydric acid, almost entirely exempt from iron, which passes through the paper and from soluble oxide of iron which remains in the dialyser.

The chloride of iron separates at about 70° into chlorhydric acid and sesquioxide of iron, soluble in water and in diluted chlorhydric acid, insoluble in most saline solutions: these are precisely the characteristics of colloidal oxide of iron obtained by Mr. Graham in the dialysis of basic solutions of iron.

It is not supposed that chloride of iron separates into chlorhydric acid and basic chloride, because the existence of these basic soluble compounds appears scarcely reconcilable with the fact of their decomposition by the septum in dialysis, or by the sea salt which precipitates pure oxide of iron.* It would seem more natural to consider these compounds as solutions of colloidal oxide of iron in chlorhydric acid, or, at least, in common sesquichloride of iron.

On heating on a water-bath, at 100°, a diluted solution of sesquichloride of iron, and carefully replacing the evaporating liquid, the soluble oxide is gradually changed into the isomeric modification of sesquioxide of iron discovered by Pean de Saint-Gilles. It will be remembered that this chemist by subjecting acetate of sesquioxide of iron in solution to the prolonged action of heat obtained a particular oxide insoluble in dilute mineral acids and in most alkaline solutions, and yielding, when mixed with water, a liquid transparent to transmitted light and turbid on reflection.

Some years later, M. Scheurer-Kestner demonstrated that the decomposition of nitrate of iron would also furnish it. According to my experiments, the production of Pean de Saint-Gilles's oxide is due to the same cause. The first effect of heat upon salts of iron with monobasic acid is to separate them into acid and oxide, which only remain separate if the acid is diluted; the next is to transform the soluble oxide into the metasesquioxide of Pean de Saint-Gilles, which differs by its state of hydration and by several of its characteristics from the colloidal oxide of Mr. Graham. Solutions of bibasic acids, like the sulphate, yield only insoluble sub-salts when submitted to the action of heat.

If De Senarmont's method be used, namely, by decomposing chloride in a diluted solution at a temperature varying from 250° to 300°, at which colloidal oxide and metasesquioxide no longer exist, the separation of the acid and oxide necessarily occur, since a temperature of 70° only suffices to effect it. The oxide, which is produced very slowly, is anhydrous sesquioxide and crystallised, that is to say, oligistic. It is unnecessary to explain the experiment of De Senarmont to introduce the influence of pressure upon the closed tube in which the experiment is made by steam strongly heated, or by an evolution of chlorhydric acid.

* This reaction of alkaline chlorides on basic chlorides was noticed for the first time by M. Béchamp (*Ann de Ch. et Phys.*)

Iron may be separated from manganese by a well-known method, as follows:—First transform the metals into chlorides; then bring the iron to the maximum of oxidation; and, after incompletely saturating the excess of acid by carbonate of soda, an excess of acetate of soda is added to the boiling liquid. The sesquioxide of iron is precipitated alone in the acid liquid. The theory of this reaction is very simple. The acetate of sesquioxide of iron, formed of a mixture of chlorides and acetate of soda, separates, on boiling, into acetic acid and colloidal oxide, insoluble in a liquid containing a notable quantity of sea-salt and acetate of soda. When washed quickly in cold distilled water, a large portion of the oxide re-dissolves; this may be avoided by washing it with a diluted solution of chlorhydrate of ammonia. It will also be easy to introduce into the liquid containing the chlorides only volatile reagents, acetate of ammonia, which produces the same effect as acetate of soda, because colloidal oxide of iron is insoluble in an ammoniacal salt, even in the presence of a large quantity of acetic acid. The separation of oxides of iron and manganese is as perfect as possible by this method; but it is preferable for exactitude in weighing the oxide of iron to pour the solution of acetate of ammonia into a hot solution of nitrates of the two bases, and to wash the oxide with a warm solution of nitrate of ammonia. The loss of iron consequent upon the action of the ammoniacal salt upon oxide of iron during calcination is thus avoided.

Aniline is actually prepared (after M. Béchamp's method) with nitrobenzol, iron, and a quantity of acetic acid much smaller than that of the quantity of sesquioxide formed. The acetate of peroxide of iron, having but little stability at the comparatively high temperature of the reaction, is decomposed into insoluble sesquioxide of iron, and into acid capable of again reacting on the metal. A small quantity of acetate of aniline should also be formed; but, if the tension of dissociation of this salt is sensible at the temperature of the experiment, it necessarily follows that a small quantity of acid will suffice to terminate the reaction.—*Comptes Rendus.*

ON THE SEPARATION OF IRON AND ALUMINA.

BY E. W. PARNELL.

Of the many methods proposed for the separation of iron and alumina effectively, no one seems to combine the very necessary qualities of accuracy and simplicity. The method of weighing the two oxides together, and then separating the alumina by fusion with caustic soda and subsequent treatment with water, is, no doubt, exceedingly accurate, but troublesome. In an accurate analysis, an analyst avoids, if possible, volumetric estimations. The plan of effecting the separation of the iron by means of sulphide of ammonium from the ammonio-citrate solution of the oxides cannot give perfectly accurate results, since the sulphide of ammonium has the power of holding up small quantities of iron in solution; this may be proved by letting the perfectly-clear filtrate stand a few days, when small flakes of sulphide of iron will be deposited.

The method about to be described (proposed, I believe, by Prof. Bunsen, of Heidelberg) is in use in some laboratories on the Continent. I have never seen it published in English, and it may possibly be new to some of your readers. To the slightly acid solution of the oxides a solution of hyposulphite of soda is added, more than equivalent to the amount of free acid present. The liquid is then boiled in a flask for about ten minutes or a quarter of an hour. The whole of the alumina will be thrown down in a fine granular state, together with the sulphur resulting from the decomposition of the hyposulphurous acid; while the whole of the iron will remain in solution. The liquid is then rapidly filtered, and the precipitate washed with boiling water, dried, ignited in a porcelain crucible, and weighed in the usual manner. The filtrate containing the iron is treated with hypochlorite of soda, nitric acid, or other oxidising agent, and the iron estimated by precipitation by ammonia and weighing as sesquioxide. Care should be taken to avoid large excess of acid, in the first instance, and also, subsequently, of the hyposulphite: the smaller the proportion of sulphur with the precipitated alumina, the more easily may it be filtered off from the iron solution. After calcination, the alumina appears as a perfectly-white, crystalline powder, much resembling precipitated and calcined silica.

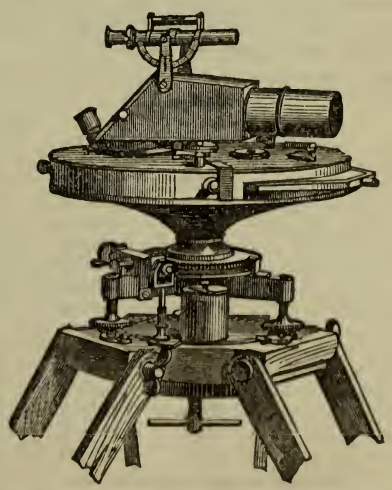
Alumina might probably be separated by this method from other metals—such as manganese, zinc, &c.; and, were phosphoric acid present, it would probably be carried down with the alumina. I have not, however, experimented on these points.

Runcorn Soap and Alkali Works,
Runcorn, Jan. 27th, 1870.

PHOTOGRAPHIC PLANE-TABLE.

We have received through the kindness of Mr. James Swaim, a pamphlet on the above instrument, invented by M. Auguste Chevalier, containing full descriptions of its working and construction, and illustrated by engravings and a photograph.

The accompanying woodcut represents an exterior



view of the apparatus as given by the photograph. It consists of a photographic objective, behind which is placed a square prism, by total reflection from whose oblique rear surface, the image formed by the lens is projected upon an horizontal sensitive plate set beneath. The lens and prism, as well as an opaque screen covering the plate with the exception of a narrow slit in a

plane passing through the axis of the lens and the centre of motion, rotate about a vertical axis in the middle of the instrument, being driven by appropriate clock-work. By this means, when the instrument is placed at one end of a base line, adjusted, furnished with a sensitive plate, and allowed to make a total revolution, it will produce an automatic photographic horizontal projection of all objects within the panoramic field, from which their various angular relations may be determined with the greatest accuracy. It might seem that sharpness of definition was incompatible with a continuous motion of the lens, but the admirable panoramic pictures produced by the apparatus of Martens and of Garella, which operate on the same principle, are a complete and satisfactory answer to this objection.—*Journal of the Franklin Institute.*

ON BAUMÉ'S AREOMETER.

BY M. BAUDIN.

Sundry divergences occur in Baumé's areometer, according to different authors. Upon examining this instrument, I found the figure given for 85 parts of distilled water and 15 parts of pure and well-dried chloride of sodium to be 1·111 absolute density at 15°. Francœur found 1·109; Soubeiran, 1·116; Terlach, 1·114; and M. Coulier, Professor of Chemistry, gives 1·110725. The work of the latter may be considered as the most important of those upon the subject.

Repeated experiments have convinced me that the figure of density 1·111 is most correct; I have, therefore, employed it to re-construct the actual scale of Baumé. The figure, 1·116, given by Soubeiran, does not correspond with Baumé's formula (85 parts of water and 15 of salt), and indicates that the instrument marks 66° in a sulphuric acid whose point of concentration is undefined: this arbitrary scale is by no means that of Baumé. Serious results arise from these discrepancies—manufacturers are uncertain as to which Baumé-areometer they should trust, and endless disputes ensue. Brisson's densimeter should be the only one employed, as any one can manage it.

Comparison of Baumé's Scale (Acidimetric) with the Scale of Density.

Baumé. Degrees.	Francœur. Density.	Baudin. Density.	Soubeiran. Density.
0	1000	1000·0	1000
5	1034	1034·4	1036
10	1070	1071·3	1075
15	1109	1111·0	1116
20	1151	1153·8	1161
25	1196	1200·0	1210
30	1245	1249·9	1262
35	1299	1304·2	1320
40	1357	1363·5	1383
45	1420	1420·4	1453
50	1490	1500·0	1530
55	1567	1578·9	1615
60	1652	1666·6	1711
65	1747	1764·6	1819
70	1853	1875·0	1942

ON ORGANIC MATTER IN THE AIR.*

BY DR. R. ANGUS SMITH, F.R.S., &C.

I have worked and written so constantly on impurities in air and water that last year I was told by a periodical of high position that I was quite regardless of the impression made on timid persons, and I began to compare myself to a collector of "varieties," who is often obliged to bring up his curiosities every five years. When I read of the new experiment by Professor Tyndall, showing to the naked eye the numberless bodies in the air, I was abundantly gratified, as I obtained them only by a laborious although simple process. When, however, Dr. Tyndall began to show the character of these bodies, it "smote the chord of self," as I imagined that I had long ago proved that not only organic and inorganic, but organised, forms exist in the atmosphere. Neither do I claim this as my original idea, looking rather to the fulness of proof and quantitative results as mine. I think, therefore, I may remind my friends of some of my work, as I find that they forget; and even I forget the exact words used by myself, and must read up.

But, as people do not read much on a subject, I will begin at the end. I have been for two years attempting to measure the amount of putrescible matter in the air of the towns and country-places; and I have succeeded to a considerable extent. I also measure the amount that has putrefied and left its remains in the air—the sewage of the atmosphere. Some of my results are published. I have promised some very soon, and some have been ready for printing, under the head of "Chemical Climatology." The proof of organic matter is old. I seek the quantity in various towns and parts of towns.

I shall not here give a history of the enquiries. So many people claim to have something to say in the matter, that I might amuse myself, if not the public, by a long account. At present, I profess to keep almost entirely to my own work. The knowledge of organic matter in the air has never been absent entirely from men's minds in historic times; but the words of Bishop Berkeley are so clear that I prefer to quote them; besides, he is far enough back for the purpose. He says, in "Siris" (par. 140):—

"Nothing ferments, vegetates, or putrefies without air, which operates with all the virtues of the bodies included in it—that is, of all nature. . . . The air, therefore, is an active mass of numberless different principles—the general sources of corruption and generation; on the one hand, dividing, abrading, and carrying off the particles of bodies, that is, corrupting or dissolving them; on the other, producing new ones into being, destroying and bestowing forms without intermission."

And, in paragraph 141, he says:—

"The seeds of things seem to be latent in the air, ready to pair, and produce their kind whenever they light on a proper matrix. The extremely small seeds of ferns, mosses, mushrooms, and some other plants, are concealed and wafted about in the air, every part whereof seems replete with seeds of one kind or other. The whole atmosphere seems alive. There is everywhere acid to corrode and seed to engender. Iron will rust, and mould will grow in all places."

No man has, before or after him, expressed this truth more completely and beautifully. It is hard to improve it by one word. Still, this age demands more detailed knowledge and exact theory. Besides, the work of every few years requires to be done again, to suit modern methods, although it must be confessed that there is room for the cynic to say that Bishop Berkeley and all the ancients and moderns might be classed with Topsy, who think they have explained all by saying—"It grows."

* Read before the Manchester Literary and Philosophical Society, Jan. 25th, 1870.

I began to examine the air in 1846, and I brought a short notice before the Chemical Society: a simple mode of obtaining organic matter in the condensed breath on windows is recorded in their transactions. On account of this commencement, which promised favourably, the British Association requested me to report on the subject. My report, published in 1848, was considered to have made advance, and was marked out for special mention by the President of the succeeding year, so that the words were not hidden. I quote a part, "That animals constantly give out a quantity of solid organic matter from the lungs, may readily be proved by breathing through a tube into a bottle, when the liquid or condensed breath will be collected at the bottom of the bottle; or by breathing through a tube into water, when a solution of the same substance will be found in the water. This would scarcely require proof if we consider that breath so frequently has an organic smell."

"If this condensed breath be put on a piece of platinum, or on a piece of white porcelain and burnt, the charcoal which remains and the smell of organic matter will be conclusive. If it be allowed to stand for a few days (about a week is enough), it will then show itself more decidedly *by becoming the abode of small animals*. These are rather to be styled animalculæ, and very small ones certainly, unless a considerable quantity of liquor be obtained; they may be seen with a good microscope. Animalculæ are now generally believed to come from the atmosphere and to deposit themselves on convenient feeding places; that is, they only appear where there is food or materials for their growth, and they prove of course the existence of that continuation of elements necessary for organic life. At the same time their presence is a proof of decomposing matter, as their production is one of the various ways in which organised structure may be broken up."

"I mentioned some time ago that I had got a quantity of organic matter from the windows of a crowded room, and I have since frequently repeated the experiment. This matter condenses on the glass and walls in cold weather, and may be taken up by means of a pipette. If allowed to stand some time it forms a thick, apparently glutinous mass; but when this is examined by a microscope, it is seen to be a closely matted confervoid growth; or, in other words, the organic matter is converted into confervæ, as it probably would have been converted into any kind of vegetation that happened to take root. Between the stalks of these confervæ are to be seen a number of greenish globules constantly moving about, various species of Volvox, accompanied also by monads many times smaller. When this happens the scene is certainly lively and the sight beautiful, but before this occurs the odour of perspiration may be distinctly perceived, especially if the vessel containing the liquid be placed in boiling water.

"If air be passed through water a certain amount of this material is obtained, but I have found it difficult to pass a sufficient quantity through. If it is made to pass rapidly, *absorption does not take place*, and evaporation of the water is the consequence; if it passes slowly, it requires several weeks to pass a 100 cubic feet through a small quantity of water. I continued the experiment for three months, but although I obtained sulphuric acid, chlorine, and a substance resembling impure albumen, I did not get enough to make a complete examination; and indeed this could not be expected, as I found that in that time less than 1000 gallons of air had passed through.

"When this exhalation from animals is condensed on a cold body, it, in course of time, dries up, and leaves a somewhat gelatinous organic plaster. We often see a substance of this nature on the furniture of dirty houses, and, in this case, there is always a disagreeable smell perceptible."—*Mems. Brit. Association Meeting, held in August*, 1848.

I quote the words used by the President of the Association simply to show that the paper was well known:—

"For instance, the causes which, in our great cities, hasten the death and debase and embitter the life of so many have at last been forced by chemists and physiologists on the notice of the public. Look at Dr. Smith's report on the air and water of towns in this volume; and, when we think that the victims of the deadly influences which are there revealed are chiefly found among the people whose industry is the foundation of our greatness,—that every year cut off from the life of each of these is so much subtracted from national wealth,—even were all moral senses and religious feeling dead in us, we must confess that the knowledge which is capable of averting them 'is of use.'"

Looking over these words at this distance of time, it seems to me scarcely possible to write more clearly, although some of the words I should prefer to see changed. Still, the subject was a continued study, and it was my strong desire to measure exactly the amount of organic matter. Not to detail all the attempts, I may come to the report to the Cattle Plague Commission in 1866, in which I give some general views and allude to the works of others. The following may be quoted:—

"It has often been asked—Will a sewer produce cholera, or plague, or cattle disease? We cannot say so, or that every kind of disease may be produced from such accumulations of organic matter. The great epidemics that have passed over Europe seem always to have come from some extraneous source, to act *as if planted by some seed*, and not to have risen up spontaneously here. Without attempting to examine this matter carefully, the result would seem to be that, whilst the decomposition of organised beings after death produces gases and vapours that are opposed to health, these gases or vapours are incapable of originating, although they may be capable of feeding, some of those diseases, such as cholera or plague, which have been observed at all times to come from a warmer climate. There must, however, be some first origin of these diseases; and we cannot prove that the first origin might not take place in our climate, although it seems probable that it requires a warmer sun and a richer vegetation than is to be found in the north. This, however, is sufficiently made out—that, when these diseases do come amongst us, they take root with most effect in those places where decomposing matter is found. If we were to suppose a seed of disease planted in a rich, fertile soil of decomposing matter, we should give a pretty fair description of the fostering effect of impurity on disease. It would, in fact, appear as if the putrid matter itself took the disease, and transferred it to the living. There seems to be nothing entirely opposed to this view of the case. The question, however, is, and has always been—What is the nature of that substance which may be said to form the seed, or germ, of the disease? Chemists have been inclined to consider it a substance in process

of decay, as the quotation from Liebig already given shows. Physiologists and microscopists have been more inclined to consider it as an organised substance. When Gay Lussac passed a bubble of air into the juice of grapes, and found that fermentation began at once, it was believed that the oxygen was the prime mover, and that when once begun, the action did not cease. When, however, Dusch and Schroeder found that flesh did not decompose if the air was previously passed through a good filter of cotton wool, some difficulty was thrown on the subject. It would appear as if oxygen were not the only agent in the atmosphere causing decomposition. The investigations of M. Pasteur, who found the subject in this uncertain condition, have advanced it so far that we may now with certainty reason in the belief that organised substances are really found in great abundance in the atmosphere (in all places), and that they are the cause of some hitherto entirely mysterious phenomena, putrefaction included. His object was first to inquire into the possibility of spontaneous generation, and he found that carefully filtered air allowed no organisms to appear in vegetable solutions. He found that near the usual surface of the ground these organisms were so numerous that whenever a vessel containing vegetable matter fit for their growth was opened for a very short time they were found to enter, that in cellars and damp and quiet places, where there was no air or dust floating about, these organisms were fewer, and that, as he ascended the sides of the Alps and the Jura, they diminished in number. A commission of the French Academy confirmed his results. If we examine previous inquiries into the compounds resulting from the decomposition of organic substances, we shall find nothing which is at all calculated to bring out such an intelligible rational view of the origin of many diseases, and also of some phases of putrefaction. Chemists, when they have examined products of the latter action have found sulphuretted hydrogen, carburetted hydrogen, hydrogen, carbonic acid, nitrogen, hydrogen, ammonia, acetic acid, lactic acid, butyric acid, and numerous uncertain bodies having no activity, and utterly incapable of producing those prodigious results that are found when that force begins to work which produces plague, small-pox, or black death."

I did not enter on Pasteur's ground—the action of organisms in producing fermentation.

After these opinions and the detail of many facts, one is mentioned which was the culminating point of the enquiry, and has led to a mode of collecting the organic particles of air, which I may call established. This word established is used because the experiment has been done by others. It is given in these few but plain words:—"The air of cow-houses and stables is to be recognised as containing more particles than the air of the street in which my laboratory is, and of the room in which I sit, and that it contains minute bodies, *which sometimes move, if not at first, yet after a time, even if the bottle has not been opened in the interval.* There is found, in reality, a considerable mass of debris, with hairs, or fine fine fibres, which even the eye, or, at least, a good pocket-lens, can detect. After making about two dozen trials, we have not been able to obtain it otherwise. Even in the quiet office at the laboratory, there seemed some indications."

"I found similar indications in a cow-house, with healthy cows. So I do not pretend to have distinguished the poison of cattle plague in these forms; but it is clear that, where these exist, there may be room for any ferment or fomites of disease; *and I do not doubt that one class is the poison itself in its earliest stage.* It would be interesting to develop it farther."

I do not detail the examination made of the condensed air brought from a cow-house by Mr. Crookes; nor do I detail the examination of the cotton through which Mr. Crookes had passed the air; nor the glycerine surfaces exposed to the air of cow-houses, which, also, was done by Mr. Crookes. My object at present is, not to give a history, but a few of the prominent points, so far as relates solely to my own part.

These experiments were repeated on air in Manchester. A paper was read, on March 30, 1868, to the Literary and Philosophical Society, Manchester, Dr. Schunck in the chair. To quote a part:—

"Lately, I tried the same plan on a larger scale. A bottle of the capacity of 4·99 c.c. was filled with air, and shaken with water. The bottle was again filled, and shaken with the same water; and this was repeated 500 times, nearly equal to 2½ millions c.c., or 2.495 litres. As this could not be done in a short time, there was considerable variety of weather, but chiefly dry, with a westerly wind. The operation was conducted behind my laboratory, in the neighbourhood of places not very clear, it is true, but from which the wind was blowing to all parts of the town. I did not observe any dust blowing; but, if there were dust, it was such as we may be called on to breathe. The liquid was clouded, and the unaided eye could perceive that particles very light were floating. When examined by a microscope, the scene was varied in a very high degree—there was evidently organic life. I thought it better to carry the whole to Mr. Dancer, and to leave him to do the rest, as my knowledge of microscopic forms is so trifling, compared to his."

Having for years, therefore, convinced myself of these results, I took the air washings to Mr. Dancer, of Manchester, whose experience in microscopic objects is so great that I was certain to be corrected, if I erred; and, if I did not err, I should be taught more. His examination is very beautiful; and it shows, not only organic substances, but very many in quality, and inconceivably many as to quantity. The whole cannot be quoted; but the following will suffice:—

"The water was first examined with a power of 50 diameters only, for the purpose of getting a general knowledge of its contents. Afterwards, magnifying powers varying from 120 to 1,600 diameters were employed.

"During the first observations, few living organisms were noticed; but, as it afterwards proved, the germs of plant and animal life (probably in a dormant condition) were present.

"1. Fungoid Matter.—Spores, or sporidiæ, appeared in numbers; and, to ascertain as nearly as possible the numerical proportion of these minute bodies in a single drop of the fluid, the contents of the bottle were well shaken; and then one drop was taken up with a pipette; this was spread out, by compression, to a circle ½ an inch in diameter. A magnifying power was then employed which gave a field of view of an area exactly 1-100th of an inch in diameter; and it was found that more than 100 spores were contained in this space. Consequently, the average number of spores in a single drop would be 250,000.

"On the third day, a number of ciliated zoospores were observed moving freely among the sporidiæ.

"Some of this formed a very interesting object, with a high power; and the greater portion exhibited what

is called pitted structure. The larger particles of this had evidently been partially burnt, and quite brown in colour, and were from coniferous plants, showing with great distinctness the broad marginal bands surrounding the pits. Others had reticulations small in diameter. They reminded me of perforated particles so abundant in some kinds of coal.

"Along with these reticulated objects were fragments of vegetation resembling, in structure, hay, and straw, and hay seeds, and some extremely thin and transparent tissue showing no structure.

"A few hairs of leaves of plants and fibres, similar in appearance to flax, were seen; and, as might have been expected in this city, cotton filaments, some white, others coloured, were numerous, red and blue being the predominant colours. A few granules of starch, seen by the aid of the polariscope, and several long elliptical bodies, similar to the pollen of the lily, were noticed. After this dust from the atmosphere had been kept quiet for three or four days, animalculæ made their appearance in considerable numbers, the monads being the most numerous. Amongst these were noticed some comparatively large specimens of *Paramecium aurelia*, in company with some very active *Rotiferæ;* but, after a few days, the animal life rapidly decreased, and in twelve days no animalculæ could be detected.

"For the purpose of obtaining a rough approximation of the number of spores or germs of organic matter contained in the fluid received from Dr. Smith, I measured a quantity by the pipette, and found it contained 150 drops of the size used in each examination. Now, I have previously stated that, in each drop, there were about 250,000 of these spores; and, as there were 150 drops, the sum reaches the startling number of 37½ millions."

After these examples, the first being twenty-four years earlier than the last, I need not add that my certain knowledge is that particles both organic and inorganic are found in air.

Further, that some of the organic particles are organized.

Lime, soda, sulphates, and chlorides have been mentioned in another paper as being found, coal-ash and, of course, carbon, and to some extent the amount measured. In railway-carriages, we even breathe rolled plates of metallic iron which are large enough to be seen by the naked eye.

Some of the most difficult particles to remove are those of coal-smoke; they are oily or tarry, or both. These are instances of organic and not organized particles.

For two years I have been endeavouring to measure with certainty the amount of nitrogen in the organic matter, separating it from the inorganic. Some of the results are in the last "Report of the Proceedings under the Alkali Act," and have been pretty extensively published. Other results are soon to be published.

I have not yet spoken of my work, "On the Air of Mines," where drawings of the particles of solid matter are given (in a long report published by the Mines Commission in 1864), because the air was from exceptional places. Still, similar results are got above ground. In the small tubes containing air from the mines and solids, I was able to detect very distinctly organic matter, and to measure the ammonia.

Still, the best proofs are in the sight of actual forms and the moving objects. In finding these with many accessories, I consider their existence in the air of such places as were tried proved beyond all doubt, also long ago proved. We now require good microscopists to examine the individual forms, and to find if every disease has one peculiar to itself, as Mr. Bailey finds every class of plants has its own peculiar pollen. That is probably the next most prolific field for those who desire something more on the subject.

We must not be panic-stricken because of these forms. Some are hurtful; but it may be that others are required for the maintenance of healthy animal life of the highest order, exactly as in vegetable fermentation. We must purify the air within the limits of natural intention, and be careful that we do not overstep its boundaries.

ON SOME

REMARKABLE SPECTRA OF COMPOUNDS OF ZIRCONIA AND THE OXIDES OF URANIUM.*

BY H. C. SORBY, F.R.S.

WHEN a scientific man has been led into an error, and afterwards discovers his mistake, I think it a matter of duty that he should take an early opportunity to correct it. I therefore now write the following notice of certain remarkable peculiarities in the spectra of some compounds of the oxides of uranium with zirconia, which led both myself and others† to conclude that they were due to a new elementary substance.

Though the spectra of the different salts of those bases which show well-marked absorption-bands often differ in detail, yet they usually resemble each other so much that there is no difficulty in recognizing each particular element. This is so constantly the case in the various compounds of erbium, didymium, and cobalt, and in the ordinary salts of uranium, that, for a long time, the more I studied this question, the more did it appear to be a general rule; and there seemed to be no reason to suspect that a few special compounds of uranium would give spectra with absorption-bands as unlike as possible those of all others. Such, however, turns out to be the fact, when its oxides are combined with zirconia.

As an excellent illustration of important differences in mere detail, but general correspondence, I would refer to the spectra of didymium in different states of combination,‡ and would especially refer to the most distinct of the numerous absorption-bands, which occurs in the yellow. The various compounds agree in showing this band in the same general position; but, by careful management, and by the use of sufficient dispersive power, it may be resolved into a very variable number of narrow bands or black lines. For example, in the case of the crystallised sulphate containing comparatively little lanthanum, it can be resolved into seven narrow lines, two of those near the centre being the darkest; whereas, when much lanthanum is present, one line on the side next the green is so much darker than the rest, that the others are comparatively absent. On fusing the mixed oxides with borax, the same spectrum is seen as with oxide of didymium alone, and I can resolve the above-named band into only two

* Read before the Royal Society, February 10th, 1870. Revised by the Author for the CHEMICAL NEWS.

† Professor Church's paper, CHEMICAL NEWS, vol. xix., p. 121, *Am. Repr. May '69, page 231:* and Professor Loew, vol. xx., p. 9; *Am. Repr. Sept. '69, page 165.*

‡ See also Bunsen's paper, *Pogg. Ann.*, vol. cxxviii., p. 100.

narrower bands; whereas, when the saturated bead is made to deposit crystals by being kept some time at a very dull red-heat, this band can easily be resolved into eight equal and very distinct black lines. Although these and similar differences, in detail, are of much interest, yet in no case are they so considerable as to prevent our recognizing at once that the spectra are all due to didymium. It is also important to notice that the amount requisite to give a most splendid spectrum, when the bead is crystalline, will scarcely show any trace of bands when in a vitreous condition, dissolved in the borax. This is analogous to what occurs in the case of solid and powdered crystals of sulphate of didymium; for the absorption-bands in the spectrum of the light transmitted by a thin layer of the fine powder, strongly illuminated from the other side, are as distinct as in that transmitted by a many times greater thickness of solid and transparent crystal. We may very conveniently take advantage of this fact in studying the spectra of such substances when the amount of material at command is otherwise too small. This seems to be because the transmitted light does not simply pass through the crystals, but is in great measure reflected from them backwards and forwards, and thus, as it were, passes through a greater thickness. It is also to a considerable extent similar to that reflected from the powder when illuminated from above, as may be clearly proved by what occurs in the case of uranic salts. These, when in a state of moderately fine powder, transmit light giving a spectrum showing not only the absorption-bands in the blue, which alone are met with in that transmitted by a clear crystal, but also those in the green, which depend on fluorescence, characteristic of that reflected from the powder.* These two kinds of bands can be easily distinguished by means of a plate of deep-blue cobalt glass, which has an entirely different action according as it is placed below or above the object, when the bands are due to fluorescence, but has no such effect when they are due to ordinary absorption. It would, perhaps, be well to mention here that I have in this manner proved that the abnormal bands seen in the spectra of the compounds of zirconia with the oxides of uranium, described in this paper, are due to genuine absorption, and not to fluorescence.

The remarkable spectrum of some jargons has been already described by me in the Chemical News (vol. xix. p. 122; *Am. Repr. May* '69, *page* 233), and in the *Proceedings of the Royal Society* (vol. xvii., p. 511). One of its most striking peculiarities is that, when light passes in a direction perpendicular to the principal axis of the crystal, and the spectrum is divided by means of a double-image prism into two spectra, having the light polarised in opposite planes, though some of the absorption-bands are of equal intensity in both images, yet others are comparatively absent, some in one and some in the other; whereas, in the case of other dichroic crystals which give spectra with absorption-bands, they are usually all more distinct in one image than when the light is not polarised, and all fainter, or even comparatively absent, in the other. No sooner had I observed this spectrum than I made various experiments in order to ascertain whether uranium was present or not; and the then known tests that could be applied to the amount of material at my command seemed to show that it was absent. This was quite in accord with the results of the various analyses published by other chemists, none of whom mention the existence of any trace of that substance. Moreover, the general character of the spectrum was entirely unlike that of all the known compounds of uranic oxide. The various artificial salts all agree in giving a variable but small number of moderately broad absorption-bands in the blue end; and the same is also seen in the case of several natural minerals; whereas the jargon gave a most unusually large number of narrow black lines (fourteen quite distinct, besides others more faint and a single broader band which I cannot separate into lines), extending from the red end; so that nearly all occur in that part of the spectrum which is entirely free from bands in all previously-known compounds of uranic oxide. This same general fact was also seen in the spectrum of the opaque blowpipe beads gently flamed, as described in my former paper.

I will not now enter into a description of the various chemical and physical facts which seemed to warrant the conclusion that zircons sometimes contain a new earth; but, taking these into consideration, there seemed to be every reason to believe that spectra which thus differed so much from those of any previously-known substance were characteristic of this new earth. Judging from the facts then known, it was more probable that spectra of such a new type were due to a new element than that they were due merely to a combination of two such elements as zirconium and uranium. Some of these chemical and physical facts can now be explained by the presence of uranium; but, besides this and several of the more common earths and oxides, I have detected, in some zircons, erbium, didymium, yttria, and another substance, which exists in such small quantity that I have not yet been able to ascertain whether or no it is the suspected new earth. These accidental constituents do not, indeed, occur in sufficient quantity to be of importance, except as modifying the physical and optical properties, the didymium giving usual characteristic absorption-bands (zircons from Sveneroe, Norway), and the manganese the same spectrum as that of garnets (zircons from an unknown locality in Siberia).* This method, however, fails to give evidence of a new earth; for, since the publication of my former paper, I have proved that the very abnormal spectra, which seemed sufficient to establish its existence, are really due to compounds of zirconia with the oxides of uranium, which have such a powerful action on light that an almost inappreciable amount is sufficient to produce the spectra to great perfection—in fact, so small an amount that the total quantity which misled me was only a few thousandths of a grain; and its presence might easily have remained unsuspected if I had not made a number of experiments which, at first, did not seem to have much connection with the subject.

In studying the spectra of crystalline blowpipe beads, it seemed desirable to examine those made with carbonate of soda, with or without a little borax. This, when melted, dissolves certain oxides; and, though it crystallises on cooling, so as to be only partially translucent, yet, with strong direct sunlight, well-marked spectra may be seen. For example, in the oxidising flame, uranic oxide is easily dissolved by carbonate of soda alone, and, when quickly cooled, an orange-coloured bead is obtained, probably containing uranate of soda in a vitreous condition, which gives a single

* See Stokes's papers. *Phil. Trans.*, 1852, p. 463, and 1853, p. 392.

* For both of these I am indebted to my kind friend Mr. David Forbes.

well-marked absorption band in the green with so small a quantity of the oxide that, in a bead ⅛ inch in diameter, 1-2000th grain shows the spectrum to the best advantage, and even 1-10,000th grain can be easily detected. We need not be surprised that this spectrum differs so much from the usual type of uranic salts, since, in this case, the oxide plays the part of an acid. It may be only an accidental coincidence, but this difference is analogous to what so commonly occurs on adding an alkali to neutral solutions of vegetable colours.* When gently re-heated, it seems as if the uranate passed into a crystalline state, for the spectrum then shows four absorption-bands, and is more like the ordinary type; but this change does not occur if a little borax had been added. The addition of more and more borax causes the absorption-band to become more and more faint, and to advance towards the blue end, until we obtain a spectrum with very faint bands, but of the usual character.

In examining the various products into which I separated jargons in order to study the supposed new earth in a state of purity, I obtained a small quantity of a dark-coloured substance (apparently zirconia) containing some oxide, which communicated a green tint to a glassy borax blowpipe bead, but yet not sufficiently distinct to show that it was due to uranous oxide. I therefore thought that the carbonate of soda method might throw light on the question; and, though the presence of zirconia prevented solution by pure carbonate of soda, the addition of a little borax enabled me to prove that uranic oxide is really present in some jargons. Such, then, being the case, it seemed desirable to ascertain whether the oxides of uranium would give rise to any special spectra when present along with zirconia in crystalline blowpipe beads. To my astonishment, I found that the spectra were precisely the same as those obtained in the case of what I had thought to be an approximately-pure new earth. When, however, I had ascertained the quantity of oxide requisite to give this result, I was no longer surprised that I had not suspected its presence. In the case of transparent blowpipe beads of borax with microcosmic salt, it is requisite to have as much as about 1-50th grain of uranous oxide to show faintly the characteristic absorption-bands; whereas, when present along with zirconia in the crystalline beads. 1-50,000th grain gives an equally well-marked spectrum; and 1-2000th grain shows it far better than a larger quantity, which makes the beads too opaque. These very minute quantities were obtained by the repeated division of a small known weight, either before or after fusion with borax. This spectrum also differs very considerably from the spectra of the usual salts or blowpipe beads of uranous oxide. On comparing them side by side, the only common peculiarity is the fact of there being numerous absorption-bands distributed over a large part of the spectrum, but they do not correspond in either number or position; on the contrary, they differ almost as much as possible; and the darker bands in the spectrum of this zirconia compound occur where the transmitted light is the brightest, in other cases.

The oxide of uranium is so easily reduced at a high temperature to the state of protoxide in a borax bead with excess of boric acid, and is so readily peroxidised at a dull red-heat when crystallised along with borate of zirconia, that there seemed good reason to refer the change in the spectra to temperature rather than to the state of oxidisation, until after it was found that they were due to uranium. By gently flaming the crystalline bead, the spectrum is entirely altered to that which seems to be characteristic of the compound of borate of zirconia with uranic oxide. This shows a spectrum with five well-marked absorption-bands, all of which occur at the red end, where there is no trace of bands in the case of the ordinary compounds of uranic oxide. I have tried many experiments in order to ascertain whether any other element besides zirconia will cause uranium to give similar abnormal spectra; but none show anything of the kind—at all events in similar conditions. A few have special characters, as described below; but the majority exert little or no influence; and, even when the blowpipe beads are crystalline, they show only the usual spectra of the oxides of uranium. Moreover, no such great change in the character of the spectra of any other elements which give absorption-bands is to be seen when they are combined with zirconia; and, as far as my present experience goes, it seems as if such very abnormal spectra were met with only in the case of these remarkable compounds of zirconia with the oxides of uranium.

Such, then, being the facts, it appears to me that we are now in a position to explain why certain zircons give three different spectra, as described in my former paper. Some jargons (usually those of a green tint) contain a little uranium so combined that the characteristic spectrum is only faintly visible; whereas, after ignition, the intensity of the absorption-bands is permanently increased to a variable extent, occasionally only a little, but, in some cases, as much as twenty-five times. This more powerful action on light is accompanied by an increase in hardness and in specific gravity (sometimes as much as from 4·20 to 4·60), as described in my former paper; and I have since found that these changes are approximately proportional to the amount of uranic oxide in the various specimens, as shown by comparing the spectra of the blowpipe beads. This change may partly depend on the oxidisation of the uranous oxide, since some specimens slightly increase in weight when ignited; but I think it cannot be mainly due to that, for sometimes there is no such increase; and uranous oxide, combined with zirconia, gives rise, not to a spectrum without bands, but to one with several of very marked character, as described below. On the whole, since this abnormal type of spectrum is so characteristic of combination with zirconia, it appears to me more probable that the effect of a high temperature is to cause the uranic oxide to combine more specially with the zirconia, as though the greater part existed naturally as a silicate, but after ignition as a zirconiate. We may also apply the same explanation in the case of zircons more or less strongly coloured by other oxides, which become almost colourless when heated; and thus this unexplained peculiarity of zircons may depend on the fact of zirconia being able to play the part of both a base and an acid, which, as compared with silica, has an affinity for bases varying according to the temperature.

The brown-red zircon from Ceylon (named at page 514 of my former paper, kindly presented to me by Mr. E. L. Mitford, of Rusthall) gives a spectrum precisely like that of the borax blowpipe beads crystallised after treatment in the deoxidising flame, and, therefore, no doubt contains uranous oxide. This spectrum, being given by only one part of the crystal, probably depended upon the presence of some substance which either reduced the uranic oxide or prevented the oxidisation of the uranous.

* See my paper in *Proc. Roy. Soc.* 1867, vol. xv., p. 433.

These facts thus clearly show that the various spectra which seemed to indicate the presence of a new element existing in three different physical conditions are, in reality, only characteristic of the two oxides of uranium, combined with zirconia or not in combination. Perhaps some may think that my having been thus led astray shows that little or no reliance can be placed on the method of investigation employed; but I contend that the mistake was due to its being such an unexpectedly delicate test for uranium; and, as explained above, the error was ultimately corrected by a further development of the same method. As far as the interests of science are concerned, there is no need to regret the general result. We have lost what appeared to be good evidence of a new earth, but have gained an almost entirely new system of blowpipe testing, which enables us to detect such a minute quantity of some substances as could not be recognised by the ordinary means. I shall not now attempt to give anything like a full account of this subject, since it would be much better to let it form part of a paper on various improvements in blowpipe chemistry, but will merely mention a few facts which have a special bearing on the question before us.

In the first place, I would say that zirconia and the oxides of uranium are most useful reagents in detecting the presence of certain substances, with which they unite to form compounds having very special characters. The most striking of these are the compounds already described, which are distinguished by the spectra, and not by any well-marked colour—the compound of ceric oxide with uranic oxide, which is of a splendid deep blue colour, but shows no absorption-bands; and that of yttria with uranic oxide, which is characterised by a deep orange-colour and extreme fusibility. Thorina and oxide of lanthanum form with uranous oxide compounds which give spectra with absorption-bands in special positions, but of the usual type, and not of such a marked character as to be useful in detecting minute quantities of those substances in mixtures.

In order to see the spectra of the zirconium-uranium compounds, it is requisite that their oxides should be combined in a crystalline condition. When both constituents are melted in borax and are held in solution, or if, when crystals are deposited, any other substance replaces either the zirconia or the oxides of uranium, the characteristic spectra cannot be seen. The most simple application of this test for uranium is in the case of various zircons. As much of the powdered mineral as will dissolve should be melted with borax in a circular loop of platinum wire about ⅛ inch in diameter, so as to give a bead of moderate thickness. A little boric acid should then be added, which not only tends to keep the uranium in the state of protoxide, but also facilitates the crystallisation of the borate of zirconia, which is far less soluble when there is excess of boric acid. The bead should then be kept at a bright red heat, just within the deoxidizing flame, until so much borax has been volatilized that small needle-shaped crystals begin to be deposited, when it must be allowed to cool rapidly. It should then be transparent with scattered crystals, and the uranium all in the state of protoxide. On gently re-heating it, the bead ought to suddenly turn white and almost opaque; and care must be taken not to heat it any more than is just requisite to cause the borate to crystallise out, or else the uranium will rapidly pass into the state of peroxide. Such beads must be examined by strong direct light from the sun, or from a lamp of very great brilliancy, condensed on them by means of an almost hemispherical lens of about ½ inch focal length; and in addition to the means described in my former paper, I have since found it very convenient to place them over a hole in a black card, so as to entirely prevent the passage of any light which has not penetrated through them, even when so arranged in the focus of the microscope that the spectrum of their thin edges may be examined, if the centre be too thick and opaque. If thus properly prepared, the presence of more or less uranium will be shown by the greater or less intensity of the absorption-bands of the spectrum described and shown in Fig. 1 of my former paper. This test is so delicate that there is no difficulty in seeing the darker band in the green in the case of zircons which contain no more than 1-10th per cent of uranic oxide; and I find that very few localities yield this mineral so free from it that it cannot be easily detected. Those from Miask, Siberia, are the only specimens in which I have not been able to recognize it. The jargons from Ceylon contain an amount varying up to about 1 per cent, although in no published analysis that I have seen is there any allusion to the presence of even a trace. It has also been overlooked in several other cases; and it now becomes important, because it gives rise to various well-defined spectra, which are so characteristic of the different minerals, that they can be very conveniently identified, even when cut and mounted as jewels, by means of the number and position of the absorption-bands, as I intend to explain in a paper on the spectra of minerals.

In applying this test to detect minute quantities of uranium in other minerals, it is requisite to bear in mind that zirconia may play the part of both an acid and a base, and that various oxides and acids so combine with the zirconia or the oxides of uranium as to prevent the formation of the compounds which give rise to the characteristic spectra. The zirconia appears to combine with some rather than with the uraneous oxide, and with others rather than with the uranic, so that, if one spectrum cannot be obtained, the other may; and there are few, if any, cases when neither can be seen, especially if care be taken to use excess of zirconia. If, however, the amount of uranium be very small, and so much of other oxides be present as to make the bead very dark, or too opaque from deposited crystals, before it is sufficiently concentrated for the compounds with the oxides of uranium to crystallise out, it may be impossible to detect it. In order to apply the test in the case of complex minerals, a bead of borax, boric acid, and pure zirconia should be prepared, then a small quantity of the mineral added, and, after fusion and sufficient concentration, the bead made to crystallise in the manner already described. If needle-shaped crystals be not deposited in the bead when very hot, and if it do not suddenly turn opaque when re-heated, the result may not be satisfactory. In this manner it is easy to detect uranium in 1-200th grain of such minerals as Fergusonite, tyrite, and yttrotantalite, even when they contain no more than 1 or 2 per cent If, in such cases, the spectrum of the uranous compound cannot be obtained, the bead should always be flamed and re-examined, to see if that of the uranic compound is thereby developed.

In a similar manner, we may make use of a little oxide of uranium to detect zirconia; but the test is far less delicate than the converse, because it is almost impossible to obtain the compound in a crystalline state,

unless there be an excess of zirconia. Not more than 1-1000th grain of uranic oxide should be employed, or the bead may be too opaque. There is no difficulty in thus detecting zirconia in zircons, or in katapleiit; but the presence of so much of other bases in minerals like eudialyte prevents our obtaining a satisfactory result. There certainly could not be a more characteristic test to confirm the results of other methods, or to identify such a small quantity of approximately pure zirconia as could not easily be distinguished in any other way.

The only other compound of uranic oxide of very abnormal character which I have so far discovered is that with ceric oxide. So much of both should be fused with borax in the oxidising flame as will yield a bead which is perfectly clear and of pale yellow colour when rapidly cooled, but crystallises when gently reheated. If the constituents be present in a certain proportion, it then turns from pale yellow to a deep blue, as though colored by oxide of cobalt. In most cases, the bead is rendered nearly opaque by the number of crystals; but sometimes, though it turns deep blue, it remains transparent, owing to the compound being set free in a state similar to that of the red oxide of copper in a borax blowpipe bead, with carbonate of soda and oxide of tin, treated in the reducing flame. The spectrum of these blue beads shows no absorption-bands, but merely a general absorption at the red end; and it is curious to find that the combination of two yellow substances give rise to a deep blue, in much the same manner as when the yellow ferrocyanide of potassium is added to a yellow ferric salt. The production of this blue colour, on the addition of a little uranic oxide, might be employed with advantage to identify moderately small quantities of cerium, even when mixed with a number of other substances; but, unfortunately, the presence of much oxide of lanthanum, which is so commonly associated with it, interferes, as though the ceric oxide had a stronger affinity for the oxide of lanthanum than for uranic oxide.

The most characteristic peculiarity of the compound of yttria and uranic oxide is that it will not crystallise out from a borax blowpipe bead, and that the affinity of the uranic oxide for yttria is stronger than for zirconia. Perhaps erbia may prove to act in the same way, but I have not been able to examine that earth quite free from yttria. On adding yttria to a bead with zirconia and a little uranic oxide, and gently flaming it in the oxidising flame, the uranic oxide combines with the yttria and rises to the surface as an orange-coloured scum, which has a great tendency to collect on the platinum wire; and, if sufficient yttria was added, the crystallised borate of zirconia is left in the interior almost colourless, and so free from uranic oxide that no absorption-bands can be seen in the spectrum. We may take advantage of this circumstance to detect yttria in small quantities of compound minerals like Gadolinite and Fergusonite; and I may here say that, by combining such means with the observation of the spectra of the transparent, or crystalline beads, and of the form of the crystals when slowly deposited, with or without the addition of suitable reagents,* we may often detect twice as many constituents in minerals as could be accomplished by the ordinary methods of blowpipe chemistry—an advantage which I am sure will be appreciated by those engaged in the study of rocks, when it is often so important to obtain satisfactory results with small quantities of material. I have also found these methods of great practical use in examining small residues in the qualitative analysis of minerals, and have thus unexpectedly discovered small quantities of comparatively rare elements.

I have tried the effect of many other substances along with zirconia and the oxides of uranium, and find that most of them have no sensible influence, unless they are present in considerable relative quantity. The most striking effect is that of oxide of tin, which causes the two absorption-bands in the yellow and yellow end of the green in the spectrum of the uranous oxide compound to be nearly equally dark; whereas, without the oxide of tin, that in the yellow is comparatively faint. This is another illustration of the manner in which certain substances having no special action on light influence by their presence the properties of another. The oxides of uranium are unusually sensitive to such actions, and thus not only lend themselves to us as blowpipe reagents, but also seem more than any others to afford the means of explaining the relation between the physical conditions of compounds and their action on light.

The only compound of zirconia with any other oxide to which I need now draw attention is that with chromic oxide, as deposited from a borax blowpipe bead. When treated in the deoxidising flame, and when cold, the very pale green bead gently re-heated, this compound crystallises out so as to give a fine red-pink colour by transmitted light, even when so little chromium is present that the glassy bead is scarcely at all green. If too strongly heated, the pink tint is lost. This compound is of interest in connection with the colour of rubies and other minerals coloured red by chromic oxide. To others, like the emerald, it communicates a green colour, and, on the whole, it acts on light in such a variable manner, according to the presence of other substances, that the spectra may be made use of as a means of identifying particular minerals, though they do not present anything like such striking anomalies as those met with in the compounds of zirconia with the oxides of uranium.

* See my paper, *Monthly Microscopical Journal*, vol. i., p. 349.

ON CHLORAL HYDRATE.

BY DR. MACVICAR, MOFFAT, N.B.

The physiological interest which attaches to this substance at the present moment induces me to present it as it presents itself in the system of molecular morphology, since I find that this may be done (though, of course, not very well) by the use of such types as are already in the hands of the printer as representatives of the forms of the elements involved.

As to the laws of chemical union and decomposition which are here referred to, or, indeed, which are ever admitted in the molecular nature which I advocate, they are all included in the law of symmetry, culminating in sphericity, towards which the first step usually is the union of dissimilars, when they come into the same neighbourhood.

It is only necessary to add (since no printer's type in use can show it) that the atom of hydrogen is the simplest structure possible into which equal and similar elements of matter or force can be built up so that it shall be truly symmetrical in relation to the sphere—that is, shall have two poles which are similar to each other, and an equator lying evenly between them. It, therefore, consists of five material units—two for the two poles, and three for the equator (for no smaller

[English Edition Vol. XXI., No. 534, pages 75, 76.]

number than three can determine a plane). As to its form (that is, the form of the nucleus, for, as to the ethereal atmospheres of all atoms, they are universally spheroidal or spherical), supposing it viewed in reference to the lines of resultant force which join the five constituent forces in the angles, and so give edges to the form, we may say that it is doubly trachar or lance-shaped. The limit of its atomicity is 5. It may possibly carry atoms of some other substance, single or multiple, piled one on each of its two poles and three on its equator, five in all, but no more.

Its symbol, as a chemical agent, may be represented by three dots in a horizontal line, to represent its equatorial atomicity, as, also, other two, one above and another below, to represent its polar atomicity.

Hydrogen: its atomicity = 5.

But, for convenience, we may take to stand for it merely a printer's dash or dagger, the former of which may represent unity, also its atomic weight on the usual scale.

Hydrogen: its usual symbol.

For oxygen, we may take the figure 8, laid horizontally, and with an uniformly-broad face. Since the atom of oxygen comes out in shape a double concave lens, like a blood-disc or life-buoy, the cypher that has been named has some resemblance to its vertical section through the centre. It is also the atomic weight of a single atom on the usual scale, the law of sphericity requiring that these atoms, when in the free state, shall go in couples,

Oxygen gas.

the atomic weight of each 16 when H = 1.

Moisture.

The atom of carbon comes out a doubly-convex lens, fitting that of oxygen, as in an achromatic arrangement of lenses; it may, therefore, be represented by a narrow letter O. As in the case of oxygen, and for the same reason, single atoms of carbon tend, also, to go in couples; but it is not possible to use the atomic weight

A coupled atom of carbon.

6 or 12 as its symbol in diagram-formulæ.

Add to these a longer letter of the same kind, to represent chlorine, and we have symbols sufficient for our present purpose.

Chlorine.

Carbon is first given to nature as the hydrocarbon, HCH = CH_2, a lengthened form of which every two

Nascent marsh gas.

under the law of sphericity unite in couples, constructing thereby a most exquisitely-spherical and finely-differentiated structure, viz., $\overset{4}{C}HC = C_2H_4$ = marsh gas.

Mature marsh gas.

The genetic atomicity of a coupled atom of carbon is, therefore, 4, in reference to hydrogen; and marsh gas is the perfect hydrocarbon. It is indestructible, if the temperature of its genesis be respected, and is most fit for existing in the aëriform state above.

But nature detains it below, by loading, during vegetation, each of the three hydrogen-arms of the equator with an atom of carbon. And this may be applied to the axial atom in so many different ways that the formula $CH(HC)_3C = C_5H_4$ will represent many substances of different properties. Of this element, the smallest

The essential-oil element.

dense molecule must be the tetratom, giving, as its formula, $4 \times (C_5H_4) = C_{20}H_{16}$, which is the chemical formula of non-oxygenated essential oils.

In regions of vegetable nature, where free carbon prevails still more, the retained hydrogen is made to go still farther, and one essential-oil element is made to yield four alkaloid elements—that is, elements in which each single atom of hydrogen is an axis loaded with five of carbon, thus saturating its atomicity.

The alkaloid element.

Unhappily, the load of carbon here is so great that this structure cannot be raised, by the chemist, into the aëriform state and sublimed. It appears to him merely in a carbonaceous residuum containing hydrogen.

But when one atom of hydrogen more is added to either pole, the atoms can ascend in couples and be sublimed, their first dense molecules being the tetratom, giving $4 \times (C_5H_2) = C_{20}H_8$, which is the usual formula of naphthaline. Respecting this substance it is impossible to say to what valuable account the ingenious chemist may yet turn it for enhancing the enjoyment of life and for the relief of suffering.

The naphthaline element.

Returning now to marsh gas, with which we set out, it is to be considered that it may be loaded with carbon on the poles, as well as on the equator. Thus, in dry and hot regions, there may be on each pole a coupled, instead of a single atom of carbon, giving $C_2H_4C_2 = C_4H_4$ = olefiant gas.

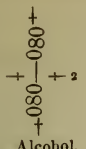
Olefiant gas.

And in moist and cool regions, there may be an atom of simple hydrate of carbon, CHO—that which we obtain from the breaking up of an atom of sugar, $C_{12}H_{12}O_{12}$—and which we may call the saccharine element, which is trimorphous.

The saccharine element.

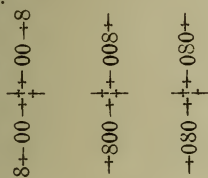
Place one of these saccharine elements—say that in the middle diagram—upon the poles of one atom of marsh gas and we obtain—

$$HCOCHCOCH = C_4H_6O_2 = \text{Alcohol.}$$



Alcohol.

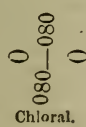
Its three forms may be represented in our figurate formulæ. The chemical formula of all the three is, of course, the same :—

Alcohol  $C_4H_6O_2$.

And this, we see, must be a very quick substance, its poles being capable of any one or other of these different structures, according to the conditions of its existence.

Under the law of sphericity, its axis is, however, too long; it is ready to lose something from its poles, and to receive expansion of its equator. Let chlorine, then, be let in upon it, so as not to disorganise it, but to improve its form, and we may expect that two atoms of the halogen will carry off the two atoms of hydrogen from the poles, as hydrochloric acid, thus shortening the axis, which was the first thing required by the law of symmetry (sphericity), and, afterwards carry off the three atoms of hydrogen now constituting the too feeble equatorial region, and leave three of chlorine in their stead. The atom of alcohol will thus be transformed into—

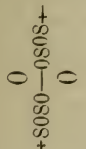
$$COCHCl_3COC = C_4HCl_3O_2 = \text{chloral.}$$



Chloral.

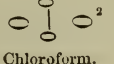
But this structure is greatly in want both of hydrogen and of oxygen; for the atomicity of a single atom of carbon is 2, in reference to oxygen, as well as hydrogen; and here there are only 2 of oxygen and 1 of hydrogen for 4 of carbon. Since, then, the law of symmetry allows it, we may expect that, on access being granted to moisture, the terminal atoms of carbon on the poles will resume their original condition of saccharines, and we shall have—

$$HO\ COCHCl_2COCOH = C_4H_3Cl_3O_4 = \text{chloral hydrate.}$$



Chloral hydrate.

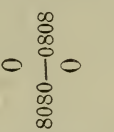
Now, as the poles (the region of chemical activity) here are saccharines, as in alcohol, there seems no reason to apprehend that this substance, so long as it keeps together in the living body, will be more poisonous than alcohol, though it must be more powerful. As to where it will break up when it is obliged to do so, this will depend on the process by which it was made (for every substance, when decomposing, other things being equal, tends to reproduce its original constituents) and on its surroundings. But, viewed in reference to its own structure, it may be regarded as an atom of chloroform, C_2HCl_3, capped on both poles by fully-oxidised saccharines—that is, by the formic element, CHO_2, the couple of which gives $C_2H_2O_4$, or $C_2HO_3.HO$ = formic acid.



Chloroform.

The formic element.

When chloral hydrate then meets with matter more powerfully alkaline than its own body (which is an atom of chloroform), the polar elements may be expected to go off, thus exposing an atom of chloroform. Suppose they were to go off as saccharines, they would do no harm, nor would the dioxide of chloroform that remained probably be so dangerous, or effective, in causing sleep ("the sister of death") as the chloroform itself. But formic acid, if by any mistake it should get free, might prove a very disorganising agent. But would not all danger from the breaking up of the polar matter be avoided, if, for chloral hydrate, trichloracetic acid could be substituted, for then there would be given



Trichloracetic acid.

off only dioxide of carbon, which is perfectly harmless and might even be useful in assisting the hypnotic action.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

February 3rd, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

Mr. Chapman read "*A Note on the Organic Matter Contained in the Air.*"

Some time ago, the author, in connection with Mr. Wanklyn and Mr. Smith, found that the smallest traces of nitrogenous organic matter in water could be detected by converting the nitrogen of the organic matter into ammonia, and then trying with Nessler's test. It occurred to the experimenters that the process might be extended to the investigation of the air, by washing it with water, and examining the water; but Mr. Chapman found the operation of washing the air more difficult than he had expected. It seemed the most obvious method to draw air through water, or through some other medium which would have afterwards to be washed with water. The absorption by water alone proved insufficient. Filters of cotton-wool and gun-cotton acted very well; but neither of the two materials could be obtained free from

traces of nitrogenous substances. Asbestos seemed to be sufficiently good; but the preparatory treatment it has to undergo before its use in the experiment is too troublesome. Lastly, finely-powdered pumice-stone was tried as a filtering medium, and was found satisfactory in all respects. It has to be heated to redness before it is employed, and is then moistened with some water, spread over coarser pieces of pumice, which rest on some wire-gauze fitted into a funnel. When a sufficient quantity of air (say 100 litres) has been drawn through the apparatus, the pumice is transferred to a retort which contains water freed from ammonia and organic matters; and the operation is now proceeded with exactly as if it were an estimation of nitrogenous organic matter in a sample of water.

By this method, Mr. Chapman found that the air of crowded rooms contains suspended nitrogenous organic matter, as well as volatile organic bases. The first can be removed by filtration through cotton-wool; the latter pass through the filter, and, when conducted into water, can be detected there. Air collected from the neighbourhood of a sewer contained notable quantities of these volatile bases. The author thinks it would be of interest to investigate, by the above-described method, the air in hospitals, fever wards, and the like places.

With respect to the examination of the volatile bases occurring in the air—

Dr. Mills suggested that the charcoal out of the Stenhouse air-filter might furnish a good means for collecting those bases.

In another paper, Mr. Chapman communicated "*Some New Reactions of Alcohols.*"

Amylic alcohol, as commonly obtained, consists of two liquids, one rotating a ray of polarised light, the other not. The two may be separated by distilling the mixture from soda, calcic chloride &c. The non-rotating alcohol is retained; the rotating distils over. But, by repeated distillations, it was found that the rotating alcohol is converted into the non-rotating by the very treatment employed to separate the two. No difference in the physical properties of the two alcohols is perceptible. The compounds of the non-rotating liquid do not turn the ray of polarised light; those of the rotating do, and that in an opposite direction to the original alcohol. These facts seem to indicate that the internal structure of organic compounds is not so permanent as we are in the habit of thinking. Another observation Mr. Chapman made whilst pursuing these experiments was that caustic soda is not merely unable to dry alcohol, but that it actually hydrates it. On proper investigation, it turned out that the sodium replaces the hydrogen of the alcohol, whilst the displaced hydrogen takes the place of the sodium in the caustic soda, and thus produces water.

The President, referring to this latter observation, remarked that it confirmed the idea of a double decomposition taking place when a potassic hydrate is dissolved in alcohol—an idea derived from the well-known reaction of carbonic acid on a solution of potassic hydrate in alcohol, whereby ethylo-potassic carbonate, as well as potassic carbonate is formed.

Mr. Perkin exhibited a modification of Berthelot's method for the synthesis of hydric cyanide by direct union of acetylene and nitrogen under the influence of the electric spark. Mr. Perkin takes advantage of the fact that nearly all the hydrocarbons yield, when submitted in the state of vapour to the action of the spark, more or less acetylene. Nitrogen was caused to bubble through benzole; then to pass through a globe, in which the spark was discharged; and thence into a solution of silver. After a few seconds, abundant evidence of the formation of hydric cyanide was obtained. Hydric cyanide was also produced when the spark was discharged through a mixture of ammonia gas and ether vapour. If, however, nitrogen, instead of ammonia, is employed, no cyanide is produced, notwithstanding that acetylene is formed from the ether. Mr. Perkin's modification of Berthelot's method is well adapted for purposes of lecture-demonstration.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, January 11, 1870.

E. P. Joule, LL.D., F.R.S., *President, in the Chair.*

"*On the so-called Molecular Movements of Microscopic Particles,*" by Professor W. Stanley Jevons, M.A.

Robert Brown, the celebrated botanist, first pointed out, in the year 1827, that minute particles of unorganised matter suspended in water exhibit movements which may easily be mistaken, and were formerly mistaken, for the movements of living animalculæ. This motion is exhibited more or less by all substances which are reduced to a sufficiently fine state of division (1-5000th inch in linear magnitude to 1-50000th), and the phenomenon is familiar to all occupied in microscopic observation. Vague suggestions have been often put forth that the motion is due to heat, to electricity, or to chemical affinity, but I have been able to find few published experiments on the subject, and those not of a conclusive kind.

In investigating this phenomenon, I did not learn much by varying the solid suspended substance. The silicates, indeed, appeared to be generally the most active substances, and the purest quartz crystal when reduced to fine powder oscillated rapidly; but such different substances as charcoal, red phosphorus, antimony, and sulphur were also very active. I cannot affirm that any substance is free from movement, but the metallic oxides, and the earthy salts, such as carbonate of lime, appeared to me somewhat less active in comparison.

In varying the liquid, however, by dissolving different salts therein, I was soon struck by the fact that the purest distilled water alone gave the movement in the highest perfection. With a few exceptions, soon to be noticed, all acids, alkalies, or salts tended to diminish the movement in a manner wholly independent to their peculiar chemical qualities.

The inquiry was much facilitated by discovering that the microscopic movement is closely connected with the suspension of fine powder in water.* Clay and pounded glass which are most active in the microscope are also capable of remaining long in suspension. All acids, alkalies, or salts which checked the motion under the microscope were found also to have a power which has not been sufficiently noticed, of precipitating suspended matter. At the same time gum arabic, which possesses a most extraordinary power of exciting the molecular movement, is also capable of maintaining powder in suspension, and has long been used for this purpose in the manufacture of ink. The molecular motion does not directly affect the gravity of the particles, but it prevents the particles from aggregating together into larger bodies and thus overcoming the resistance of the liquid.

That the motion is due to electricity I was soon convinced, by the close analogy with the circumstances in which electricity is produced by the hydro-electric machine. Armstrong and Faraday found that pure water in this machine alone produced much electricity, and that almost any salt, acid, or alkali prevented the action by rendering the water a conductor. Ammonia, however, is a remarkable exception, because it does not render water a good conductor, and does not prevent the hydro-electric machine from giving off electricity. In trying ammonia as an *experimentum crucis*, I found that it did not stop the microscopic movement, and had almost an inappreciable effect in precipitating suspended matter. A solution of 10 per cent of ammonia would have less effect than 1-100th per cent of sulphuric acid. The proof is rendered practically certain by the fact that boracic acid, which was also ascertained to be a non-

* I have since found that the microscopist Dujardin noticed this connection. See "*Manuel Complet de l'Observateur au Microscope.*" Paris, 1843, p. 60.

conductor by Faraday, does not precipitate matter from suspension.

It is right to add, however, that in the case of acetic acid there is a discrepancy; Faraday stated that it does not render water a conductor; but I find that, in common with the other vegetable acids which I have tried, it occasions precipitation. The conducting qualities of the substance have not been determined with sufficient accuracy to render a mistake impossible.

It is probable that silicic acid does not render water a conductor, as I find that silicate of soda tends to increase rather than diminish microscopic movement, and is another remarkable exception to the general precipitating power of soluble substances.

I entertain no doubt that microscopic movement is closely connected with the phenomena of osmose so fully investigated by the late Mr. Graham. The connection is that of action and reaction; for if a liquid is capable of impelling a particle in a given direction, the particle, if fixed, is capable of impelling the liquid in an opposite direction by an equal force. The earthenware jars used by Graham in many of his experiments are composed of a substance highly active under the microscope, and the fact that osmose is most shown by very dilute solutions (1 per cent or less) is entirely in accordance with the electric origin of the phenomenon.

I consider it to be established experimentally that the microscopic movement is due to electric action, and if I may venture to suggest a somewhat speculative explanation of the action I would point to the experiments of M. Wiedemann on electric osmose. It was first observed by Mr. Porret that when the poles of a battery are placed in two portions of water separated by a porous division, not only is some of the water decomposed, but another and far larger portion is impelled towards the negative pole. M. Wiedemann, having exactly investigated the phenomenon, found that, for one part of water decomposed, 5,000 parts were transported through the porous septum. This impulsion is greater as the resistance of the liquid is greater, and ceases altogether when sufficient acid or salt is added to render it a good conductor. Every particle which is thrown into a polar condition by the action of water must be capable in a minute degree of exerting a similar force. In ordinary osmose the particles being fixed cause a transportation of the fluid; in microscopic movement, on the other hand, the particle is free to move, and the reaction of the liquid probably produces those movements which are visible in the microscope.

Although I have chiefly confined my attention to inorganic substances, I have also found that all organic solid particles which are sufficiently small exhibit the movements in a high degree. Albumen, dextrin, grape or cane sugar, starch solution, alcohol, &c., seem to have little or no power of destroying the motion, and the extraordinary properties of gum arabic have been noticed. I think it not unlikely that when these phenomena are fully investigated they will give strong support to a theory lately put forward by M. Becquerel, that the movements of fluids in animals and plants, which have often been attributed by Graham and others to osmose, are really due to minute electric currents.

Mr. Dancer, F.R.A.S., stated, that the subject which Professor Jevons brought before the meeting, was one to which he had paid attention at intervals for the last thirty years. He had repeated Dr. Robert Brown's experiments with the majority of the substances named in his paper, and had also experimented with a great number of other substances and different solutions.

The particles approaching a spherical form gave evidence of the greatest activity, with some few exceptions. The activity and duration of the movements vary according to their magnitude and also the solution in which they are suspended. For instance, some of the metallic oxides would exhibit the movement for some time, and then gradually get aground on the glass plate, and cease to move. There was some difficulty in reducing metals to particles sufficiently small and regular in form for the exhibition of the molecular movement; even hardened steel, when rubbed on a very fine hone, appears fibrous, and soft metals, such as platinum and copper, like shavings, under a high magnifying power. Those siliceous particles of the hone which have their lines of cleavage favourably situated are frequently detached in thin plates during the act of grinding, and form brilliant objects when viewed by polarised light. Metals reduced in this manner require re-grinding several times before they lose their fibrous character, and become sufficiently minute for successful experiments.

Metallic oxides vary considerably in their form and magnitude, according to the solutions from which they are precipitated. By practice it would be possible, in many cases, by their microscopical appearance, to name the solutions from which they had been precipitated. The activity of these, when of favourable size, say from the 1-30000th to 1-50000th of an inch, is very different, being great in water, solution of gum, sugar, &c, but quite inactive in oil.

Mercury and sulphur when sublimed assume a spherical form, and although these spheres could be obtained from 1-1000th to 1-50000th of an inch in diameter, they do not exhibit any movement in water. He has sublimed them on to a drop of water, but they refused to sink. Possibly their polished surfaces retained a film of air which floated them. So transparent and perfect in form are the sulphur spheres that they distinctly exhibited the image of a lamp flame at their focal point. Triturated or precipitated sulphur will exhibit active movement in various solutions. As regards the cause of this so-called molecular movement, Mr. Dancer thinks that chemical action will not account for it. Diamond dust, graphite, and other refractory substances, are found to be active in water and solutions of gum. Nor is electricity a satisfactory explanation to him. He has found that particles did not show a marked alteration in their movements when exposed to electrical influence. The results of many experiments point to heat as a probable cause, and although the peculiar movements of these particles appear like electrical attraction and repulsion, similar movements might be caused by the changes of temperature of the particles transmitted through the solutions.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section).

Ordinary Meeting, January 31, 1870.

Dr. William Wallace, F.R.S.E., *Vice-President, in the Chair.*

Mr. John Christie, of Alexandria Turkey Red Works, Dumbartonshire, read a paper on "*The History of Madder, the Various Investigations Relating to its Character and Composition, and the Proposed Sources of Artificial Alizarine.*"

The author, with considerable detail, traced the history of madder dyeing, from its origin in Eastern India, 3000 years ago, through Persia, to Adrianople, Greece, Italy, and Western Europe. The colours were first obtained from Munjeet; then came into use the Turkey madder root. This plant was first grown in England in 1624, at which time three qualities were known—cropp, fatt, and mill madders. In the year 1798 there were only eleven madder mills in the whole of France, while now in the department of Vaucluse alone there are no fewer than fifty in operation. French madder root has a peculiar smell, and a taste between bitter and sweet. Some kinds, as those of Alsace and Holland, when mixed with water and allowed to stand for some time, give a thick jelly; this is not yielded to the same extent by Avignon madder. If this madder is treated with an acid it produces a perceptible effervescence, owing to the quantity of calcic carbonate which it contains.

Towards the close of last century, scientific investigators and the more intelligent of the dyers and printers were led from various circumstances to suppose that madder contained two colouring matters, a red, and what they then called a

tawny colour. The author mentioned the results of the investigations of Watt, Charles Bartholdi, and Hausmann, and stated that, in 1823, M. T. Kuhlman published a complete approximate analysis of madder. That chemist found a red colouring matter, which he specially searched for, and another matter of a fawn colour, which he did not consider worthy of investigation. He prepared the red colouring matter by steeping madder roots in water for twenty-four hours, then boiling the washed madder with a fresh quantity of water, filtering the decoction hot, and then adding sulphuric acid, when a flocculent precipitate of an orange colour was produced. He again filtered and washed the precipitate with acidulated water. What he thus obtained was his *matière colorante rouge*. This he purified by dissolving in absolute alcohol, to which a small quantity of dry pulverised potassium carbonate was added; the alcohol acquired an intense crimson-red colour. After filtering and allowing the filtrate to evaporate spontaneously, he obtained small crystals like fern leaves, and having the following properties:—(1), Great solubility in alcohol, and imparting to it a beautiful red colour; (2), solubility in water, the colouring matter altering in the concentrated solution, and being precipitated; (3), the solubility in water greatly facilitated by alkalies without any material alteration of the shade; (4), it is precipitated as an orange colour from solutions by acids.

Mr. Christie next referred to the researches which were made on Alsace madder by Robiquet and Colin, and published in 1826. Those chemists obtained two colouring substances, one of them being what they considered no other than the particular colouring substance of madder, and which they named *alizarine*, from the modern Greek name for madder. The other substance they considered to be a modification of alizarine, and from the colour which it took when freed from the acid used to precipitate they called it *purpurine*. In the following year, by pursuing a somewhat different process, Gautier de Claubry and Persoz obtained two colouring matters—*matière colorante rouge* and *matière colorante rose*. Their distinctive properties are thus shown:—

Red.	*Rose.*
Fracture brilliant.	Fracture resinous.
Attacked by ammonia warm.	Attacked by ammonia cold.
Caustic alkalies give red colour.	Caustic alkalies give purple colour.
Insoluble in alum liquor.	Freely soluble in alum liquor.

In the hands of the same chemists madder yielded, by treatment with sulphuric acid, and subsequent washing with cold water, a preparation of great tinctorial power, which was at first called *sulphuric carbon*, and sometime later *garancine*. The manufacture of this substance on the large scale was undertaken by MM. Lagier and Thomas, of Avignon, in 1829.

The author gave a full outline of the investigations which Dr. Edward Schunck made in 1848. Seven substances were obtained by Schunck: two colouring bodies, two resins, a bitter substance, pectic acid, and a dark-brown substance. One of the colouring bodies was alizarine, to which he gave the formula, $C_{14}H_{10}O_4$; for the other, which he named *rubiacin*, he proposed the formula $C_{32}H_{22}O_{10}$. Pursuing a different process, Dr. Debus, in the same year, investigated Zeeland madder. He called one of the colouring bodies *lizaric acid*, and proposed for it the formula $C_{30}H_{20}O_9$; and the other he called *oxy-lizaric acid*. Its composition was:—

Carbon	66·40
Hydrogen	3·86
Oxygen	29·74
	100·00

The last-mentioned substance was obtained to the extent of about 4 or 5 grains from 20 lbs. of madder.

Drs. Wolff and Strecker, pursuing a process very similar to Schunck's, obtained, in the year 1850, both alizarine and purpurine. The latter they regarded as oxide of alizarine. Their conclusions were summarised thus:—

I. Madder contains two colouring matters—alizarine and purpurine.

II. Alizarine changes into purpurine when madder is fermented.

III. Alizarine and purpurine, when oxidised with nitric acid, give phthalic acid.

IV. Chloronaphthalic acid is chloride of alizarine.

According to Strecker, if the formula of alizarine be taken as $C_{10}H_6O_2$, and one atom of chlorine be substituted for one atom of hydrogen, an interesting relationship is observable between that compound and chloroxynaphthalic acid, $C_{10}H_5ClO_3$. The author said it would thus seem likely that alizarine, or a body very similar to it, might be produced from chloroxynaphthalic acid. Schützenberger and Lauth have replaced the chlorine in that compound by hydrogen, but the new body had not the properties of alizarine, the composition of which, according to Schützenberger, is very probably $C_{20}H_{12}O_6$. P. and E. Depouilly, by boiling chloride of chloroxynaphthalic acid, $C_{10}H_5ClO_3.Cl$, with solution of potash, and subsequent treatment with mineral acids obtained as a yellow crystalline powder a body which sublimed in beautiful needles, and whose alumina salt is a deep red, like the colour given by madder. The iron salt is nearly black, and although it resembles alizarine in many points, Schützenberger states that trials made at Mulhouse to use it had not been satisfactory.

The next point referred to in the history of alizarine was the fact that Dr. Anderson, of Glasgow, had treated opianic acid, $C_{10}H_{10}O_5(=C_{10}H_6O_3+2H_2O)$, with sulphuric acid, and obtained a colouring matter which was probably alizarine, as it yielded all the madder colours on alumina and iron mordants. According to Clark, who obtained a patent for the process in 1861, artificial alizarine is obtained from dinitronaphthaline, and is capable of yielding all the madder colours. More recently Professor Rochleder, of Prague, has obtained, besides alizarine and purpurine, a small quantity of a colouring matter which reacts very like chrysophanic acid obtained from rhubarb root. When crystallised from absolute alcohol it has the composition $C_{14}H_{10}O_4$, and when it is distilled with powdered zinc it yields anthracen, $C_{14}H_{10}$. Graebe and Liebermann noticed that natural alizarine, by distillation with powdered zinc, yielded a hydrocarbon which, instead of being naphthaline, $C_{10}H_8$, as they expected, proved to have the same composition as Dr. Anderson, Berthelot, and others had given to anthracen, and believing that this was the proper source to start from in the preparation of artificial alizarine, they set to work to test the truth of the opinion. They were so far successful that they obtained a product closely allied in many of its properties to the colouring matter of madder, and in December, 1868, they obtained provisional protection for their process in this country. Mr. Christie detailed the process, stating that the patentees obtain in the first stage of the process anthrachinon, $C_{14}H_8O_2$, by the use of bichromate of potassium—

$$(C_{14}H_{10}+K_2Cr_2O_7=C_{14}H_8O_2+2KHO+Cr_2O_3).$$

In the second stage they convert the anthrachinon into bibromanthrachinon, $C_{14}H_6Br_2O_2$, a solid substance which is purified by crystallisation from benzol. In the third stage this new compound is transformed into artificial alizarine by treating with potash, heating to 180° or 260° C. till a deep-blue colour results, then dissolving in water, filtering, and precipitating the alizarine by acid. They obtained provisional protection for a second patent last year.

Pursuing a somewhat different course, Julius Brönner and Hermann Gutzkow, of Frankfort-on-the-Maine, matured a process which they patented in May, 1869, and which, they state, yields two colouring matters that can be employed for dyeing or printing, either with or without mordants. One of them colours alcohol yellow, and the other colours it red or violet.

Mr. Christie completed his historical *resumé* by referring to Mr. W. H. Perkin's process, patented 26th of June, 1869, by which artificial alizarine is obtained from anthracene, by oxidising with bichromate of potassium to produce anthrachinon—a process which has recently been modified by the use of a new acid derived from anthrachinon in place of bibromanthrachinon.

The author then referred, at considerable length, to experiments which he had recently made with Perkin's artificial alizarine, and with one made by a secret process by MM. Lucius and Co., of Hoechst, near Frankfort. Amongst other things, he stated that while natural alizarine, prepared from the finest garancine, fused at 320° F., and was almost entirely sublimed by exposure to a temperature of 340°, the artificial alizarine only yielded a sublimate when the temperature was raised to 420° F. There was no fusion, and only 15 per cent of the powder was sublimed, even though it was kept at a temperature of 450° for a whole hour. No fusion ensued, and no further sublimate was produced, though the powder was slowly heated to 600°, at which temperature it was kept exposed for some time. Mr. Christie showed to the members an interesting experiment to demonstrate the truth of his opinion that artificial and natural alizarine are not identical. He placed swatches of dyed cloth in caustic soda solution (30 grs. to the gallon of water). Those dyed with the artificial alizarine of Perkin and Lucius and Co., in a short time threw off a deep crimson colour, which rose to the surface of the cloth, and, flowing down the swatch, fell in streaks through the alkaline liquor; while those dyed with natural alizarine and with garancine threw off no colour to affect the soda solution. He had found that selected crystals of artificial alizarine had only one-half the tinctorial power of the natural product. He concluded by saying that, from the several experiments which he had made, his opinion was that, although the substance now sold as artificial alizarine may be the best attempt to produce the alizarine of madder by chemical means, in its present state it is far from being identical with it.

A very animated discussion followed, in which Messrs. Anderson, Hogg, J. W. Young, Smith, Paterson, and the Chairman took part.

Mr. Hogg strongly combated the opinion that the two products are not identical. He questioned the absolute purity of Mr. Christie's artificial alizarine, and said that, unless it was not only sublimed, but several times recrystallised from alcohol, it would be impure; and, further, that the colouration imparted to the alkaline liquor was doubtless due to the presence of another colouring matter which is known to be present in ordinary commercial artificial alizarine. He also stated that mordanted cloth dyed with pure artificial alizarine stands soaping better than that dyed with garancine: that was the testimony of many persons who had worked with the colour.

Mr. J. W. Young said that he had found that cloth prepared with the artificial alizarine would stand even boiling with soap.

Mr. Smith stated that he considered that he had established the identity of the crystals of the two products by microscopic examination.

In proposing a vote of thanks to Mr. Christie, the Chairman referred to the highly interesting nature of the enquiry, and complimented that gentleman upon the extensive researches in which he had been engaged, as shown by his very elaborate paper. The proposal was most heartily agreed to.

NOTICES OF BOOKS.

Our Domestic Fire-places. A New Edition, entirely Rewritten and Enlarged, the Additions completing the Author's Contributions on the Domestic Use of Fuel, and on Ventilation. By Frederick Edwards, jun. London: Longmans, Green, and Co. 1870.

This work treats on a most important subject, since it is one of the more difficult things in domestic economy to utilise fuel well, and to derive from it the greatest benefit with the least expenditure of combustible matter.

The work before us is divided into four chapters, and to each of these are added a series of lithographed plates for illustration. The first chapter treats chiefly on the history of fire-places and the substitutes in use even at comparatively recent times. We find recorded at page 5 that, at as late a period as the end of last century, before the introduction into England of the system of heating by hot-water circulation and by close stoves, large areas (including the Chamber of the House of Commons) were heated by charcoal or coke, burned in the open brazier. The second chapter gives a short account of the improvements in fire-places which have been effected during the present century. The third chapter treats on the improvements to be still effected in the domestic fire-place, and on the means for better diffusing the heat of the open fire-place, and thereby avoiding inequalities of temperature in the apartment. Under this heading, eight sub-sections are introduced, viz.—(1) By using the best form of grate; (2) by using the most suitable materials for the construction of the grate; (3) by improving the fire-bars; (4) by using the fire within a chamber of fire-brick and checking the supply of air from below; (5) by checking the escape of the warm air of the room into the chimney; (6) by giving a supply of air in proximity to the fire-place, instead of from doors and windows; (7) by doubly-glazing the windows—(As regards this particular, any one acquainted with the Continent must wonder at the fact that the mansions and abodes of the better classes are not more generally provided with double windows: this is a very frequent occurrence on the Continent, and contributes largely to retain the heat generated by fire-places); (8) by utilising the heat which escapes from the chimney. The fourth chapter is entirely devoted to the description of stoves, caloriféres, and the various modifications thereof, and to such subjects as heating by hot water, hot air, and steam.

We regret that space forbids us to enter into even one or two of the many interesting details this work contains. It bears on every page the mark of careful research, and abounds to such an extent with useful matter that we should desire to see it studied and its contents brought into actual practice by all those who are in any way concerned with the important branch of domestic economy on which it treats.

As is usual with the eminent firm who published the work, its execution leaves nothing to be desired.

The Body and its Health; a Book for Primary Schools. By E. D. Mapother, M.D., &c. Dublin: John Falconer. London: Simpkin, Marshall, and Co. Pp. 127.

It is an excellent sign of the increased desire of knowledge such as is contained in this little book, as well as of the excellence generally speaking of its contents, that the first edition was, as we learn from the brief preface, sold off in three days. *De tous les capitaux celui dont le peuple est le plus prodigue est leur santé* was long ago said by an eminent French *savant*. Health is wealth; and whatever promotes the first is highly conducive to the latter. How can we expect the "*mens sana in corpore sano*" where that *corpus* is neglected through sheer ignorance?

This book is filled with really useful knowledge, and treats on subjects of the highest importance. We have here an epitome of anatomy, physiology, dietetics, and hygiene rendered accessible and easily comprehended by the young readers it is intended for. Interspersed through the context, we meet with a great many brief facts relating to chemistry, which, since they are applied in a proper manner, are very useful; although on page 42, we think the reason given for the purity of sea and country air as being due to ozone, is one for the truth of which no sufficiently reliable data have as yet been found. Sea air undoubtedly contains some chlorine and always finely-divided, almost-pulverised salts.

Country air owes much, if not all, of its purity to its freedom from dust and smoke, the effects of meadows, and trees, and growing crops; to the absence of high buildings, the lesser impediments of free circulation; and last, but not least, to freely running brooks and water-courses.

The book is very well illustrated with a number of wood-cuts; and it is not only excellent for the youth, but many full-grown people may be taught a useful lesson by its perusal.

The Pharmacopœias of the London Hospitals. By Peter Squire, F.L.S. London: Churchill and Sons.

The Pocket Guide to the British Pharmacopœia. London: Hardwicke.

Mr. Squire's well-arranged and capitally-printed book must prove of great service to the doctors. Arranged in groups for easy reference and comparison, it contains the pharmacopœias of seventeen London hospitals, and thus serves as a standard of the therapeutical practice of the present time.

The "Pocket Guide" seems to comprise the essentials of the British Pharmacopœia," conveniently arranged in a small compass for the busy practitioner to carry handily.

Acetopathy, or the Application of Medical Chemistry to Acute and Chronic Diseases. By Francis Coutts. Edinburgh: Bell and Bradfute; John Menzies and Co. 1870.

The author of this pamphlet makes the following assertion: "I have diligently studied medical chemistry for the past twenty years, and am happy to be able to announce my discovery of an agent applicable to almost every disease, and which is based on purely chemical principles. That agent is acetic acid."

After a perusal of this quotation, our readers will surely agree with us in thinking that any critical remarks of ours would be superfluous. We need only add that the *proper acid* to use is that tested by the author, the price of which is two shillings per quart bottle, and carriage!

Notes for Students in Chemistry; being a Syllabus of Chemistry and Practical Chemistry. By Albert J. Bernays, Ph.D., F.C.S., Professor of Chemistry and Practical Chemistry at St. Thomas's Hospital, London. Fifth Edition. 1870. Churchill.

We are glad to welcome a new edition of this little book. It has been considerably extended, and, as far as we have examined it, it appears to be remarkably accurate. Every chemist who takes it up will be struck with the vast mass of information which the author has condensed into a few small pages. The book really contains the essence of a bulky manual of chemistry. To students preparing for examination it must be invaluable.

CORRESPONDENCE.

Colophonic Hydrate.

To the Editor of the Chemical News.

Sir,—Observing in the Chemical News (vol. xx., p. 38; *Am. Repr., Sept.*, 1869, *page* 147) Mr. Tichbourne's account of colophonic hydrate, it may be worth while mentioning the result of an analysis which I made shortly before leaving England, in 1866.

Some white, needle-shaped crystals that had formed in an old sample of rosin-spirit were purified by sublimation and submitted to combustion. 0·112 grm. gave 0·239 CO_2 and 0·112 H_2O.

	Found.	($C_{10}H_{16} + 4H_2O$).
Carbon	58·19	57·70
Hydrogen	11·11	11·53
Oxygen	30·70	30·77
	100·00	100·00

The crystals fused below 100° C. They were soluble in water and neutral.

I observed, about the same time, that crystals of a similar appearance quickly formed in rosin spirit which had been distilled in a current of steam.—I am, &c.,

Alexander M. Thomson.

University, Sydney, N.S.W.,
Dec. 2nd, 1869.

Reactions of Disulphide of Carbon with Baric and Calcic Hydrates.

To the Editor of the Chemical News.

Sir,—In Watts's "Dictionary" (vol. i., p. 776) the reactions of disulphide of carbon with the fixed caustic alkalies are given, but those with baric and calcic hydrates are omitted, nor are they to be found in any of the addenda. I have, therefore, thought that perhaps the following notes might be worth insertion.

A solution of baric hydrate, agitated with carbonic disulphide, rapidly turns to a dark purplish brown colour, changing to a dirty green, and, lastly, to a brownish yellow solution with a small quantity of dark brown deposit, this final result being precisely similar to that obtained after a much longer period of time with sodic or potassic hydrate, as, in the time required to produce the purplish brown colour with the baric hydrate, a pale brownish yellow only could be obtained with the sodic or potassic hydrate. A solution of calcic hydrate with carbonic disulphide produces, after long stirring and standing, only a pale brownish yellow solution, a result to be expected from the inferior solubility of the calcic to the other hydrates. The reaction is, of course, similar in all cases, viz., the formation of carbonates and sulpho-carbonates.—I am, &c.,

Henry Mathews.

The Bessemer Process for Making Steel.

To the Editor of the Chemical News.

Sir,—Mr. Norman Lockyer, in his lectures upon the spectroscope, delivered a few weeks ago before the Society of Arts, stated that this instrument was of great service in directing the Bessemer process of making steel; I have, however, been informed by others that it is perfectly useless for this purpose, since it does not afford any indication denoting that the blast has been kept on for a sufficient length of time.

Perhaps Mr. Lockyer, or some other gentleman, will kindly publish sufficient of his *practical experience* to settle this question. Such an act of courtesy will oblige both your correspondent and many other students.—I am, &c.,

A. B.

Spectrum of the Bessemer Flame.

To the Editor of the Chemical News.

Sir,—In the last number of the Chemical News there is an inquiry respecting the application of spectrum analysis to the Bessemer process of making steel, to which I am able to give a tolerably definite reply. I have not myself been called upon to use it practically, but have had frequent opportunities for examining the flame and of hearing the results of the great experience in the manufacture of the steel at the works of Sir John Brown and

Co., from my friend Mr. W. Bragge, who was the first to suggest its application, and employed Professor Roscoe to make the necessary observations. Though a well experienced person can determine the time when the blast should cease, from the general colour of the flame, yet I am informed that a direct-vision spectroscope is found to be of great value, and is often employed.

According to my own observations, the flame at first gives a continuous spectrum without bright or dark lines, but in a while the sodium line appears, and afterwards several bright red, green, and other lines. There are also developed dark lines, as if from absorption, which becomes more and more distinct, and then more and more faint; and when the spectrum is just free from these dark lines the blowing should cease. I am informed that there are certain special lines which should be carefully observed, but I am unable to describe them definitely. As far as I have been able to judge, the spectrum method would very much assist a comparatively inexperienced observer, but I am by no means persuaded that it would be sure to give better results than those attainable by experience from the general colour of the flame, as seen by the naked eye; though, even in that case, it might be valuable for particular purposes. On adding the spiegeleisen, dark bands are again seen, so as to give rise to a most remarkable spectrum.—I am, &c.,

H. C. Sorby.

Broomfield, Sheffield.
February 14, 1870.

Spectrum of the Bessemer Flame.

To the Editor of the Chemical News.

Sir,—Your correspondent "A. B." will find reliable information on the application of the spectroscope to this process in Roscoe's "Spectrum Analysis," p. 107. The workmen invariably tell the proper time to stop the blast by a change in the appearance of the flame. Although I have watched the process very many times, I was never able to determine the precise point with any exactitude from the appearance of the flame to the naked eye, but with the spectroscope it is easy to determine the point with the utmost exactitude. The temperature of the flame steadily increases from the commencement of the blow until the blast is stopped. About six or eight minutes after the blast has been turned on, a group of red lines makes its appearance; this group is characteristic of carbon and increases in brightness until the carbon has been all burnt out of the iron, when it suddenly disappears.

It is thus extremely easy by watching this group to determine the exact point at which the blast should be stopped, and when watching the flame with the spectroscope I found that the time during which the blast was continued, under the direction of the manager, often differed, sometimes by as much as eight or ten seconds from the proper time as tested by the spectroscope, and by observing whether the charge had been "underblown" or "overblown," I was able uniformly to predict the quality of the steel. Those engaged in the process say that the spectroscope is useless, that it is of no consequence, that the process requires to be watched by a practised eye, and that they prefer to make steel of various qualities to be afterwards sorted than to make steel always of one quality. The experiments which I carried out on this subject at Crewe gave extremely interesting results, and I have no doubt that valuable information as to the change which takes place might be obtained by a further spectroscopic examination of the flame.—I am, &c.,

W. Marshall Watts.

Manchester Grammar School.

Spectrum of the Bessemer Flame.

To the Editor of the Chemical News.

Sir,—In answer to your correspondent "A. B.," I can assure him that the spectroscope is quite capable of indicating the period of "blowing" in the Bessemer process.

By examining the flame through certain coloured glasses, the changes occurring in it can be more easily determined, however. Two blue glasses with a dark yellow glass between give the best combination, and can be used with safety by the most inexperienced, as its indications are so marked and unmistakable.

For further information on this subject I refer "A. B." to a paper I read before the chemical section of the Philosophical Society of Glasgow, "On the Examination of the Flame of the Bessemer Converter," which was published in the Chemical News of April 9, 1869 (*Am. Repr. June*, 1869, *page* 286), or he can have the paper in the form of a pamphlet by sending me his address.—I am, &c.,

Thomas Rowan.

Laboratory, 42, Bath Street, Glasgow.
February 14, 1870.

Brown's Active Molecules.

To the Editor of the Chemical News.

Sir,—Will you allow me to suggest that if Professor Jevons examines the interesting phenomena brought by him before the Manchester Microscopical Society, and reported in your last number, on the principle of the surface tension of liquids, he will find the clue he is in search of.—I am, &c.,

C. Tomlinson.

Highgate, N., February 14, 1870.

Trivalent Elements.

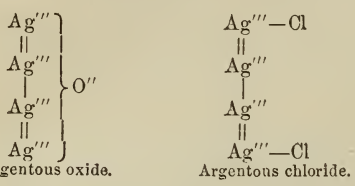
To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xx., p. 293; *Am. Repr., Feb.* 1870, *page* 80), Mr. J. A. Wanklyn brings forward a new theory of the equivalency of sodium. Sodium has generally been regarded as a monad element, which degree of chemical force it exhibits in most of its salts; but when we arrive at the so-called double salts (the chloro-platinates and the chloriodides, for instance), this monovalency of sodium is extremely vague.

But it must be remembered that shifting the equivalency of one element is a difficult process; for we know that potassium forms salts which are analogous in composition, if not in constitution, with those of sodium. Mr. Wanklyn objects to the hydrate of sodium being written as derived from water, on account of its caustic and extremely active properties; whilst the original type is, in itself, an admirable example of neutrality. Potassium hydrate, being analogous in composition, and possessing the same properties, it is quite rational to expect their constitution should be the same. The simple salts of the two metals can be thoroughly explained by the new theory, as Mr. Wanklyn himself shows in the case of sodium; but there is a point of much more importance than this and that—the explanation of the constitution of the double salts.

Although we have no combination of three monads with sodium or potassium, we have compounds in which sodium unites with an apparently triad element. Thallium, in certain respects, acts as an atom of potassium—it forms a hydrate, chloride, &c. This metal is classed as a triad; and why not sodium and potassium? Triad thallium unites with triad iodine. Triad potassium also unites with iodine.

Thus it may be seen that the alteration of equivalency as proposed by Wanklyn is of unlimited application as regards the now-denominated monad metals. Fownes's "Manual" (p. 360) contains a foot-note, to the effect that, if the formula for argentous oxide (Ag_4O) is correct, oxygen must be a tetrad. And, on the preceding page, chlorine is made to act as a triad, in order that the constitution of argentous chloride may be explained; but, by classing silver as a triad, the difficulty vanishes—



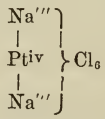
Argentous oxide. Argentous chloride.

But, to return to the compounds of sodium and potassium, Wanklyn gives sodium iodide as $INa'''=Na'''I$; but the existence of iodine trichloride is sufficient evidence for the support of the trivalency of that element. If there exist, however, in the molecule *two atoms* of the haloid constituent, we must refer iodine back to the monad list; but, at present, it certainly appears as a combination of two triads—$Na'''I'''$.

Extending the use of this polyvalency of sodium and the analogous metals, we may demonstrate the constitution of the alkaline sulphides, and their subsequent transformation into sulphates under the influence of oxidising agents, sulphur appearing in its highest degree of chemical force—

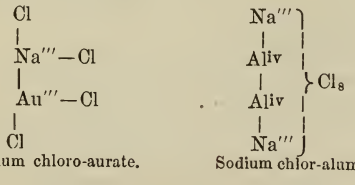
Sodium sulphide. Sodium sulphate.

These formulæ also extend to the potassium and silver salts. But difficulties soon arise; for, by giving to potassium or sodium chloroplatinate the formula—

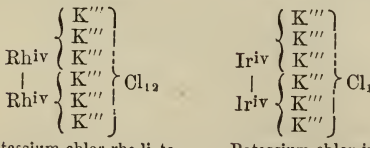


we must ignore the existence of the hydrogen salt, unless we give hydrogen also a triadic signification.

The following formulæ will, perhaps, give an idea of the so-called double salts:—



Sodium chloro-aurate. Sodium chlor-aluminate.



Potassium chlor-rhodiate. Potassium chlor-irridite.

The above formulæ will show that Wanklyn's views admit of much extension; being in the same isomorphous group as thallium, and acting as that element in all but the thallic salts, sodium, potassium, and silver, although their poly-haloid combinations have not yet been discovered, are with all probability trivalent elements.—I am, &c.,

George E. Davis.

Eton, Feb. 7, 1870.

Reactions of Disulphide of Carbon with Baric and Calcic Hydrates.

To the Editor of the Chemical News.

Sir,—With reference to a letter on the above subject in your last number from Mr. H. Matthews, I have several times observed a reaction between calcic hydrate and carbonic disulphide, which I have not seen mentioned anywhere, and which you may, perhaps, think worth recording.

Instead of using a solution of lime in this reaction, if milk of lime be employed, and if this be agitated with carbonic disulphide for a short time and then allowed to stand, in the course of twenty-four hours bright orange-red coloured needles will begin to make their appearance in all parts of the sediment. They slowly spread and increase in number and size and in a month or more will have accumulated in considerable quantities.

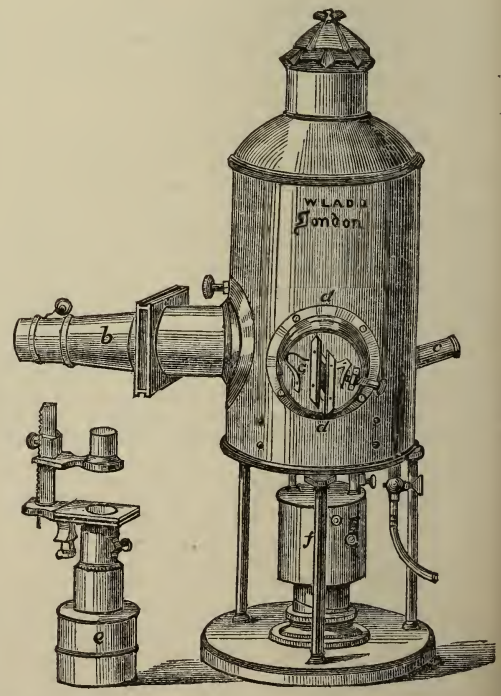
Not having analysed this product, I am unable to say whether it consists of calcic sulphide or of calcic sulphocarbonate.—I am, &c.,

J. Gulson Burgess.

Leicester, Feb. 9, 1870.

MISCELLANEOUS.

Improved Electric Lantern.—Since spectrum analysis has been discovered a great inconvenience has been felt by lecturers in being compelled to use two lanterns—one for exhibiting the spectrum, and the other to project on the screen a direct ray of light, a photograph, or other object. When only one lantern was used it was requisite to disconnect the apparatus, and revolve the lantern in order to project the object on the screen, and as it has been found inconvenient to show all the spectrum experiments together, and diagrams, &c., afterwards, the loss of time in getting the prisms and lenses to their required position, and re-adjusting the lantern, is considerable. These inconveniences Mr.



Ladd has entirely overcome by his new form of lantern, which is provided with two openings—one placed facing the screen, and the other at an angle of about 100° from it, this being about the proper angle when two prisms containing bisulphide of carbon are used for producing a spectrum. But as the angle must vary, according to the distance from the screen, one of the openings is provided with an adjustment for that purpose. The lantern is also provided with a small opening at the back, at the same height as the other two, for the reception of a sliding tube, carrying a lens at one end which focuses on a piece of ground glass, at the other an image of the carbon points. This enables the operator not only to see what is going on at the points, but also to keep them at an exact height, so requisite in many experiments. As an example of the utility of this arrangement, we will suppose the operator wishes to project on the screen an image of the arc as well as the spectrum of any particular substance; to do this he closes the slit, and focuses the arc by means of the optical arrangement facing the screen, and while the metal is still burning he closes this opening and opens the slit, when immediately a spectrum of the substance appears in the same part of the screen. The lantern is entirely of metal, and is also provided inside with a gas-jet and stopcock to enable the operator to perform his work in a darkened room.

Correlation of Vital and Physical Forces.—Preliminary trials having shown that any change of temperature within the skull was soonest manifested externally in that depression which exists just above the occipital protuberance, a pair of these little (thermoelectric) bars was fastened to the head at this point; and to neutralise the results of a general rise of temperature over the whole body, a second pair, reversed in direction, was attached to the leg or arm, so that if a like increase of heat came to both, the electricity developed by one would be neutralised by the other, and no effect be produced upon the needle, unless only one was affected. By long practice it was ascertained that a state of mental torpor could be produced, lasting for hours, in which the needle remained stationary. But let a person knock on the door outside the room, or speak a single word, even though the experimenter remained absolutely passive, and the reception of the intelligence caused the needle to swing through 20°. In explanation of this production of heat, the analogy of the muscle at once suggests itself. No conversion of energy is complete; and as the heat of muscular action represents force which has escaped conversion into motion, so the heat evolved during the reception of an idea is energy which has escaped conversion into thought, from precisely the same cause. Moreover, these experiments have shown that ideas which affect the emotions, produce most heat in their reception; a few minutes' recitation to one's self of emotional poetry, producing more effect than several hours of deep thought. Hence it is evident that the mechanism for the production of deep thoughts accomplishes this conversion of energy far more perfectly than that which produces simply emotion. From a Lecture by Professor G. F. Barker, before the American Institute, reported in the *Scientific American*.

Sweating Gold Coins.—The trial of Clifford for sweating gold coin presents many points of interest. It is the first case of the kind for thirty years. The facts were as follows:—The attention of the police being directed to a number of light sovereigns that found their way into circulation in a certain district, the coins in question were traced to a little girl, who, it appeared, acted for her father. When Clifford was arrested, he was seated in front of a battery, and although he may not have been working at the moment, still two sovereigns, each light to the extent of nearly two shillings, were found in his pocket. The scientific witness, Mr. W. Chandler Roberts, clearly showed that the wires that had sustained the sovereigns in the decomposition trough had been attached to the positive or dissolving electrode, and that the battery had not been employed for electro-gilding. Clifford threw into the fire the contents of a tea-cup, and as the chemist of the Mint produced in court gold extracted from the cinders, it is probable that the fluid was the actual solvent employed. Commenting on this, the *Pall Mall Gazette* says:—"In an official report bearing the signatures of the late Master of the Mint and Colonel Smith, F.R.S., it was suggested that a Mint charge should be imposed upon gold coin sufficient to defray not only the first cost of manufacture, but also the expense of replacing the worn coin after a certain period by new pieces of standard weight. It was proposed that as a coin would fall below current weight in eighteen years, it should be brought to the Mint at the expiration of that period and exchanged for a new piece. The recent trial of Clifford for 'sweating' sovereigns by the aid of an electric battery, and more especially the evidence of the scientific witness as to the facility with which such an operation can be carried out, suggests that if the plan in question were adopted, a positive bribe would be offered to ingenious but dishonest individuals to tamper with the coinage, and then present the damaged coin for exchange at the Royal Mint."

Chemistry in the House of Commons.—We are glad to find that Mr. U. J. Kay-Shuttleworth has been elected Member of Parliament for Hastings. Mr. Shuttleworth possesses a thorough knowledge of chemistry, and is the author of a valuable text-book for students. He will, we are sure, prove a warm advocate of technical education, and at no time has it been more important to send scientific men to Parliament than the present, when the great question of education is to be brought forward, and, we hope, settled in a manner satisfactory to all classes.

Preparation of Alizarine from Madder.—M. Schützenberger.—Take some yards' length of genuine Turkey red dyed cotton which has been cleansed (*avivé*), cut it up in suitable pieces, best ribbon-like shreds; pour upon it a quantity of strong alcohol (85 per cent strength) well acidified by means of concentrated sulphuric acid, and digest for some days without application of heat; pour off the liquid from the rags and saturate accurately with ammonia (excess is carefully to be avoided), when, by a mixture of ammonia and sulphate of alumina, alumina is thrown down. This is separated by filtration, and the filter washed with some alcohol; the liquid is next concentrated by evaporation on a water-bath, and afterwards water is added, causing a precipitation of mixed fatty and colouring matter; this precipitate is thoroughly dried, and, when dry, exhausted with rectified sulphide of carbon, which dissolves fatty matter, leaving almost perfectly pure alizarine, which, however, if desired, may be sublimed by being placed in a porcelain capsule, and heated on a sand-bath to about 250°. This method yields a pure substance, and, as regards quantity, a very satisfactory result, while the operation is far easier than when either madder or its alcoholic extracts are employed.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Archive Neerlandaises des Sciences Exactes et Naturalles, vol. xiv., 1869.

Extent of Surface Occupied by the Deposits of the Various Geological Formations in the Netherlands.—M. Hartogh Heys van Zouteveen.—From this paper, we learn that the following geological formations are found in the kingdom above named:—Jurassic terrain; cre-

taceous terrain tertiary formation; quartair formation, sub-divided into diluvium and modern, or recent formations. The extent of each, and of every distinct species thereof, is accurately exhibited; the curious result arrived at is that 99·9 per cent of the soil of the Netherlands belongs to the quartair formation, while all the rest occupies only about 0·1 of the entire surface (3,283,927 hectares), fully more than 13,000 English square miles. No other country on the face of the globe presents a similar physical constitution.

Estimation of the Velocity by which a Luminous Ray is Carried Forward through a Moving Medium.—M. Hoek.

Refraction and Dispersion of Flint Glass, Crown Glass, Quartz, and Iceland Spar.—MM. van der Willigen.

Comptes Rendus des Séances de l'Académie des Sciences, January 17, 1870.

This number contains the following papers and memoirs relating to chemistry and allied sciences:—

General Theory of Chemical Action and the Necessity of its Introduction and Use to Prevent Errors being made.—M. Maumené.—This paper was read, but is not published. From an account of the meeting at hand, we learn that this very revolutionary chemical paper, containing direct attacks upon the most eminent living, as well as deceased, authorities of chemical science, has been remanded to the section for chemistry.

Dispersion of Light.—M. Ricour.—A continuation of a former paper on this subject, and strictly algebraico-physical.

Some Silicified Vegetables met with near Autun.—M. Regnault.

Nickelisation.—M. Gaiffe.—The author states, in a letter read at the meeting by M. Dumas, that he desires to call the attention of the members to a variety of objects electro-nickelised, sent to the place of meeting. He also calls attention to the fact that the presence of even the smallest quantity of potassa, or soda, or alkaline earths in the bath containing the nickelising preparation is injurious to effect a properly-adhesive coating of the metal. The use of perfectly pure double chloride of nickel and ammonium, or of perfectly pure sulphate of nickel and ammonium, and, moreover, of pure nickel, as one of the electrodes is required. By these means, the nickel is made to adhere regularly and strongly, and only requires polishing after the metal coated over is taken from the bath.

Spectra of the Simple Gases.—M. Wüllner.—This paper is a defensive reply from the author against the remarks made by M. Dubrunfaut on his former paper concerning this subject.

Synthesis of Normal Propylic Alcohol by Means of Ethylic Alcohol.—M. Rossi.—The author converts chloride of ethyl into cyanide of ethyl, and next converts that cyanide, by means of well-known methods, into propionic acid. From the lime-salt of that acid propionic aldehyde is obtained; this is a clear, very mobile liquid, soluble in water, exhibiting a suffocating odour, boils at 49·5°; at 740 m.m. barom., sp. gr. at 17°, 0·804; formula, C_3H_6O. By hydrogenising this aldehyde, the propylic alcohol is obtained. After having been purified, this liquid exhibits the following properties:—Boils at 96°; barom., 743 m.m.; sp. gr. at 0°, 0·8205; formula, C_3H_8O. The author describes, at some length,—Bromide of propyl, C_3H_7Br; iodide of propyl, C_3H_7I; cyanide of propyl; acetate of propyl—

$$\left.\begin{matrix}C_2H_3O\\C_3H_7\end{matrix}\right\}O.$$

January 24, 1870.

This number contains the following memoirs and papers relating to chemistry and allied sciences:—

Electro-Depositing of Nickel upon Other Metals.—M. Becquerel.—Eight years ago, the author applied, for the purpose of electro-deposition of nickel upon other metals, the same method as described at the previous meeting by M. Gaiffe and his associates. M. Becquerel now states that, since the last meeting, he has purposely repeated some of his former experiments, with the express view of ascertaining whether the statement made by M. Gaiffe, concerning the injurious action of the presence of potassa be correct or not. The result of experiments is that the presence of potassa is not at all injurious to, and in no wise affects, the deposition of nickel, since the double sulphate of nickel and potassa can be applied, as well as the double sulphate of nickel and ammonia; but if the positive electrode is not made of nickel, it is necessary to add free ammonia, in order to saturate the sulphuric acid which is set free.

Election of a New Corresponding Member.—M. Kirchhoff has been elected corresponding member, in lieu of Mr. Forbes, deceased.

Discovery of Diamond at Dlaschkowitz (Bohemia).—M. Schafaritz.—At 60 kilometres (37·26 English miles) north-west from Prague, in a mining district belonging to Count Schönborn, a stone was found a few weeks ago, which, on having been forwarded for assay to the Polytechnic School at Prague, turned out to be a diamond. Its weight is 57 milligrms.; sp. gr., 3·52: its shape, irregular; its crystalline form, a rhomboidal dodecahedral. This discovery is interesting in more than one respect—in the first place, this specimen is the first genuine diamond found in Europe (the Ural mountains produce diamonds, but not on European territory); secondly, because of the geological formation wherein this specimen occurred, a formation quite different in character from that wherein diamonds have been found hitherto in other parts of the world. The locality alluded to is stated by the author to yield several other kinds of precious stones.

Constitution of Luminous Spectra.—M. Lecoq de Boisbaudran.

Freezing of Water, and on Saturated and Non-Saturated Gaseous Solutions.—M. Barthelemy.—This paper contains the description of some experiments made with the view to explain some irregularities observed by the author when ice was formed at −10° or −12° under peculiar conditions. The author states that, as result of his experiments, the so-called, or, rather, averred explosive force of ice is untenable and does not agree with its plasticity, and that the gases contained in the water, becoming liberated and compressed by the formation of ice, are the cause of the explosive action of that material.

General Theory of Chemistry; Preparation of Oxy-Ammonia.—M. Maumené.—The author's chief aim is to explain, by a peculiar theory of his own invention, certain reactions which take place when nitrate of ammonia, or other alkaline nitrates, are acted upon by nascent hydrogen. 200 grms of nitrate of ammonia are mixed with 2170 grms. of hydrochloric acid (sp. gr. 1·12) and 552 grms. of tin, and care taken to keep this mixture in a very cool flask or retort. After the action is finished, the fluid is treated with sulphuretted hydrogen, next, some alcohol is added, and also some chloride of platinum. After proper purification, a substance is obtained which is soluble in absolute alcohol, and containing 52·6 per cent of hydrochloric acid; mixed with oxide of copper, this substance yields deutoxide of nitrogen. When pure chloride of ammonium is acted upon by a solution of nitrate of silver, care being taken to leave a slight excess of the former salt—in this sense, that there be not enough nitrate to decompose the

chloride entirely, there is formed (after filtration, of course) a liquid which, concentrated by evaporation to a syrupy consistence, deposits a peculiar salt, which, at a comparatively low temperature, gives off deutoxide of nitrogen.

Variable State of Electric Currents, and on Extra Currents.—M. Blaserna.

Experiments on the Intrapolar Currents of a Grove Element.—M. Royer.

Nature of Ozone.—M. Dubrunfaut.—We shall return to this paper.

Improvement of Wines by Electricity.—M. Scoutetten.—The author states, in the first place, that a series of experiments, made on the large scale and with various sources of electricity, led to the result that electricity, under whatever form applied (whether as a regular current or a succession of discharges accompanied by sparks), improves wine, rendering it mellow and mature. As to the mode of action of this agent, the author thinks that the bitartrate of potassa present in wine is decomposed: the potassa set free saturates the acids of the wine, and the free tartaric acid, reacting upon the fatty matters present, favours the formation of the ethers which constitute the *bouquet* of the wine. Moreover, a small quantity of water is decomposed, and the oxygen thereof reacts upon some of the constituents of the wine, thereby forming new compounds which are peculiar to old wines.

Cosmos, January 22, 1870.

Artificially-Prepared Alizarine.—The Société Industrielle de Mulhouse has just proposed to grant its medal of honour to him who shall introduce artificially-made alizarine at a sufficiently low price, so that it may be available for general use, instead of and to perfectly answer all the purposes to which madder or its preparations are now applied in calico-printing and dyeing. The competitor is bound to make and deliver a quantity of this product equal to, at the least, 40,000 kilos. (40 tons' weight) of madder; the product, moreover, must be such that, by the methods of mordanting, &c., now in use, it will yield the same shades of colour and of the same good quality as madder or its preparations. This notice also states—(1) That the artificially-made alizarine prepared by MM. Meister, Lucius and Co., at Hoechst, near Frankfort, yields, especially for red and puce, results which leave nothing to be desired. (2) M. Pernod, from Avignon,* have just requested MM. Steinbach and Rack, of Mulhouse, to report upon the tinctorial value of a sample of a newly-discovered pigment extracted from the wash-waters of the madder while being converted into garancine; the same gentlemen have also been requested to report upon a sample of oxalic acid obtained from the same source.

Detection of Butyric Acid in Glycerine.—M. Pérutz.—According to the author, concentrated glycerine should simply be mixed, for this purpose, with very strong alcohol and concentrated sulphuric acid, when butyric ether is at once formed and easily recognised by its peculiar pine apple-like smell. Since glycerine often contains large quantities of butyric acid, the author proposes to treat with alcohol the animal charcoal employed for the decolouration of the glycerine; the butyric acid is retained between the pores of the animal charcoal in the state of butyrate of lime soluble in alcohol. The material thus recovered may be applied to the manufacture of butyric ether or butyric acid.

January 29, 1870.

Gold Found in the Rivers of the Scandinavian Peninsula.—M. Meunier.—The quantity of gold dust occurring among the sand of the beds of the northern rivers of Sweden and Norway is larger in quantity than has been hitherto generally known; three men have made, within six weeks, a sum of £80 each, by washing the sand and collecting the gold contained therein of one of the rivers.

Annalen der Chemie und Pharmacie, December, 1869.

This number contains the following original memoirs and papers:—

Ketonic Acids.—M. Wichelhaus.—The intention of the author is to point out the limits, and reduce to regular classification the products of the oxidation of hydrocarbons. There are four different modes by means of which an atom of oxygen can combine with a hydrocarbon (provided the relative position of the carbon atoms remains unaltered.) The following are instances of these four types:—

$CH_2.OH$	$CO\,H$	CH_3	CH_2 } O
$CO\,.OH$	$CO.OH$	CO	CH }
		$CO.OH$	$CO.OH$
Alcohol, or oxy acid.	Aldehyde acid.	Ketonic acid.	Oxy acid.

The paper next contains the following separate sections:—
Relation of pyro-uvic acid and acetone—

CH_3	CH_3
CO	CO
CH_3	$CO.OH$
Acetone.	Pyro-uvic acid.

(pyro-uvic acid bears the same relation to acetone as propionic acid to propan); products of the action of bromine upon pyro-uvic acid; substitution products of bibromo-pyro-uvic acid; distillation of pyro-uvates.

Naphthol and Carbonaphtholic Acid.—M. Eller.—When diazo-naphthaline prepared by means of the action of nitrous acid upon naphthylamine, is boiled with water, naphthol, $C_{10}H_7.OH$, is obtained; but this mode of preparing naphthol, although modified in various ways by the author, only yielded traces of the substance alluded to. The author, therefore, considered it better to prepare naphthol by means of the decomposition of naphthaline sulphoacid salts by fusing caustic potassa. The fused mass is first dissolved in water, decomposed by means of hydrochloric acid, and, after a further purifying process, naphthol is obtained as snow-white brilliantly-crystalline solid substance, fusing at 92°; formula, $C_{10}H_8O$. When naphthol is acted upon by sodium and carbonic acid, it yields a new product, carbonaphtholic acid, $C_{11}H_8O_3$, or—

$$C_{10}H_6 \begin{cases} OH \\ CO.OH, \end{cases}$$

a solid substance, hardly soluble in water, readily so in benzol, ether, and alcohol, and fusing at about 187°. The salts of this acid are all rather difficultly soluble in water.

Isomeric Naphthols and some Derivatives thereof.—M. Schæffer.—In the introduction to this paper, the author refers, at some length, to the researches on this subject, first and foremost of Faraday, and next of MM. Liebig, Regnault, Berzelius, Wöhler, and many others. There exists—*a* naphthol, $C_{10}H_7.OH$, obtained from naphthalin-sulphate of lead; this *a* product is characterised by its behaviour with hydrochloric acid; for, if a splinter of fir-wood is dipped, first into an aqueous solution of *a* naphthol, and then in hydrochloric acid, and then exposed to sunlight, the wood is first coloured green, and at last a brownish red colour. *β* naphthol also exhibits this reaction, but it is more rapidly performed: and when the wood is dipped afterwards in a weak solution of bleaching powder, a yellow tinge is produced. The author describes, at length, naphthol-ethyl ether, $C_{10}H_7.OC_2H_5$; naphthol-ether, $C_{12}H_{12}O$; *a* and *β* naphthol-acetyl-ether, $C_{10}H_7.OC_2H_3O$;

* There is no firm in existence so largely interested in the trade and everything relating to madder, garancine, &c., as this very extensive commercial and manufacturing firm.

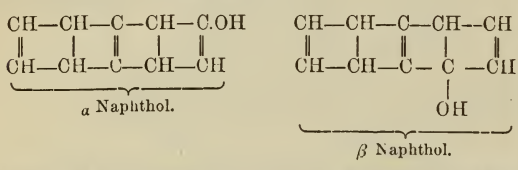
phosphate of naphthol-ether, $PO.(C_{10}H_7O)_3$; carbonaphtholic acids; α and β naphthol-sulpho acids—

$$C_{10}H_6 \begin{cases} OH \\ SO_3H, \end{cases}$$

and several of its salts.

Derivatives from Naphthaline.—MM. Darmstädter and Wichelhaus.—A lengthy memoir divided into the following sections:—Binitro-naphthol and bichloro-naphtho-chinon from α naphthol; dinitro-naphthaline; bromo-sulpho acids of naphthaline; naphtho-bioxyl; bicyanide of naphthaline; bicarbo-naphthalinic acid.

Contribution to the Knowledge of the Constitution of the Derivatives from Naphthaline.—M. Wichelhaus.—We reproduce the formulæ in this paper, since they are, according to the author, the formulæ expressing the constitution of the naphthols—



Crystallised Algaroth Powder, and on Oxychloride of Antimony.—M. Schaeffer.—When absolute alcohol and chloride of antimony are placed together in a sealed tube and heated to about 150°, in the proportion of 1 molecule of chloride of antimony and 3 molecules of alcohol, there is found, on opening the tube, that, while chloride of ethyl escapes, the sides of the tube are lined with a crystalline mass, which, after having been thoroughly washed with alcohol, proved to consist of chlorine and antimony, without any organic substance, the formula being $Sb_4Cl_2O_5$, the same which has been adopted for the *Pulvis algarothi* of the pharmaceutists Another experiment, made with equal molecules of alcohol and chloride of antimony, led to the formula SbOCl; and the reaction is represented by—

$$SbCl_3 + C_2H_6O = Sb\begin{Bmatrix} OC_2H_5 \\ Cl_2 \end{Bmatrix} + HCl;\ Sb\begin{Bmatrix} OC_2H_5 \\ Cl_2 \end{Bmatrix} = = SbOCl + C_2H_5Cl.$$

Constitution of Epichlorhydrine.—M. Darmstädter.—By first causing chloride of phosphorus to act upon epichlorhydrin, and next adding to the product so obtained a quantity of bromine, a fluid was obtained which, by means of fractional distillation, yielded a liquid boiling at about 200°; sp. gr., at 15°, 2·004; formula, C_3H_5BrCl. This substance is identical with chlorhydrodibromhydrine; and the author states that the following formula—

$$\left.\begin{matrix} CH_2Cl \\ CH \\ CH_2 \end{matrix}\right\} O + PCl_3,Br_2 = \left\{\begin{matrix} CH_2Cl \\ CHBr \\ CH_2Br \end{matrix}\right\} + PCl_3O$$

represents the reaction, and thus proves the correctness of the view that epichlorhydrine does not contain hydroxyl.

Preparation of Zinc Ethyl.—M. Wichelhaus.—The gist of this paper is that it is best to apply, for the purpose of the preparation of zinc ethyl, coarsely-divided, that is to say, roughly-filed, zinc, which exhibits a great many points of contact.

Aceto-Chlorhydrine from Octyl-Glycol.—M. Clermont.—The author describes, at some length, the preparation and rectification of aceto-chlorhydrine by means of anhydrous acetic acid, anhydrous hypochlorous acid, and pure octylen. The aceto chlorhydrine thus obtained is a very mobile, colourless liquid, exhibiting a pleasant aromatic odour and burning taste, insoluble in water, but soluble in alcohol, ether, and acetic acid; it is capable of burning, with a smoky greenish coloured flame; boils at 225°, without decomposition; sp. gr. at 0°, 1·026; formula, $C_{10}H_{19}ClO_2$; vapour density, 7·12. On being treated with caustic potassa in a sealed tube at 180°, a liquid was obtained boiling at 145°; formula, $C_8H_{16}O$—that is to say, octylen oxide.

Uric, Formic, Glycolic, and Glyoxylic Acids, Products of the Oxidation of Glycerine by Nitric Acid.—M. Heintz.—A lengthy memoir, wherein the author minutely describes the method applied by him for proving the four substances named to be produced when glycerine is acted upon by nitric acid.

Contribution to the Knowledge of Sulpho-Nitrogen Acids (Schwefelstickstoffsauren Corps Sulfazotes of Fremy).—MM. Claus and Koch.—This paper, having also appeared in another German periodical, has already been abstracted (see Chemical News, vol. xx., p. 323; *Am. Repr.*, *February*, 1870, *page* 114).

Observations and Critical Remarks upon M. Linnemann's Paper "On the Conversion of Butyric Acid into Normal Primary Butyl Alcohol."—M. Lieben.—This short paper is a rather sharp reply to some remarks made by M. Linnemann upon the author's researches on this subject.

Moniteur Scientifique, No. 314, January 15, 1870.

This number contains the following original papers relating to chemistry:—

Bromide of Sodium.—M. Casthelaz.—This paper treats, at length, on the different modes of the preparation of this salt—viz., by direct action of bromine and caustic soda solution; by the decomposition of bromide of iron by means of either caustic soda or its carbonate; by double decomposition of the bromide of ammonium by caustic soda or carbonate of soda. This latter method is used on the large scale by the author, who describes in this paper the arrangements made by him to obtain a product free from chlorine, as well as from iodine.

Researches on the Yama-Mai Silk.—Dr. Bolley.—The silk alluded to is the product of a worm native of China, and feeding on oak leaves instead of on those of the mulberry tree. It appears, from this paper, that several parcels of that silk have been sent to Europe; but at Lyons, as well as at Zurich, great difficulties have been encountered in working up this silk along with, or in the same manner as the ordinary silkworm product. Several gentlemen have investigated the microscopical structure of the Yama-mai silk, and found it in almost every respect to differ from the silk hitherto generally used. The chemical composition, also, of this newly-imported substance differs; it has been found to contain, in raw state, 8·639 per cent of ash, while good raw Italian silk only contains 1·07 per cent; but, when the Yama-mai silk is first treated with some alcohol, next with dilute sulphuric acid, and then cleansed in a soap-bath, the quantity of ash is decreased to 0·59 per cent, while raw Italian silk treated in the same manner, leaves 0·95 per cent of ash. The fibroine and gummy matter of both kinds of silk have been proved identical; the colouring matter of the Yama-mai variety appears to differ from that of ordinary silk. Under perfectly identical conditions, the last-named variety of silk is more hygroscopical than the ordinary kind. Direct experiments instituted by the author have proved that the newly-imported material has a less affinity for mordants than ordinary silk, and both kinds submitted to dye-baths of the same composition and simultaneously have been proved to differ greatly as regards the colour assumed.

On Phenyl Brown, so-called Phenicienne.—MM. Bolley and Hummel.—This substance, also called *rothéine*, is not to be confounded with the brown colouring matter made by Messrs. Roberts, Dale, and Co., at Manchester. The phenyl brown of M. Roth's invention is a substance which, without the use of any mordant, yields, upon silk and woollen fabrics, fast colours. Since it has

been alleged that the brown dye alluded to is possessed of explosive properties, the authors have investigated the manufacture and the reactions which take place during the process. The authors find that, when a mixture of nitric and sulphuric acids (1 part of the former of a sp. gr. of 1·35, and 2 of the latter, concentrated) are made to act upon phenol, two different products are always produced—one of these, a solid substance, sometimes like thick tar, sometimes grainy; and a deep red-coloured liquid. When this latter is poured into cold water, a pulverluent brown-coloured substance is precipitated, which possesses all the characteristic properties of commercial phénicienne. The result of the researches arrived at by the authors is that phénicienne is a compound mixture of binitro-phenol and a peculiar amorphous substance which has some likeness to the ulmic and humic substances, but the precise nature of which has not been ascertained.

Action of Shellac upon some Aniline Colours.—M. Labouret.—When a salt of rosaniline is added to a solution of any resin, that solution is red-coloured, if the salt of aniline is soluble in the solvent used to dissolve the resin; the colour has, however, a tendency to turn violet as soon as the solution is heated or evaporated to dryness. An alcoholic solution of shellac, to which fuchsine has been added, turns, on evaporation, to a most magnificent blue colour. This material is insoluble in ether, but soluble in alcohol and acetic acid, the solutions exhibiting a blue colour. The product is, however, very unstable; and the only use this reaction could be turned to is, according to the author, the detection of shellac among other resins, since a very minute quantity of the last-named resin may by this means be detected.

Les Mondes, January 20, 1870.

Nickelising.—It appears that, as the result of researches instituted by MM. Adams, Gaiffe, and Boston, a company has been formed in America (U. S.) with the view of nickelising—*i.e.*, covering other metals, by galvano-plastic means, with a more or less thick coating of pure nickel. Since that metal is very hard, it resists, even in thin layers, rather rough usage; it is not oxidised, even in contact with water, at the ordinary temperature, and the metal assumes a brilliant polish if required. The method employed for the deposition of nickel will be fully described, since this subject was treated of at length at the meeting of the Academy of the 17th instant. The secret of the success is the use of a preparation of a very pure double sulphate of ammonia and nickel. The Company alluded to have established a branch manufactory at Paris under the management of M. Gaiffe.

Species of the Genus Equus.—M. Sanson.

January 27, 1870.

Cast-Iron Stoves.—Dr. Sacc.—The author mentions that some experiments made in his laboratory fully prove that cast-iron stoves, even if they are allowed to become red-hot, are not injurious to health, provided care be taken to insure a proper ventilation and draught in the chimney, or, rather, in the pipe leading from the stove into it. The use of cast-iron stoves, the author says, is not injurious to health, but becomes so only with imperfect draught; and that defect impairs the good use of all kinds of stoves, no matter whether they be made of cast or wrought-iron, or of any other material.

Use of Hypophosphoric Acid in Agriculture for the Purpose of Destroying Noxious Insects.—M. Martin.—The author proposes, more especially for the purpose of destroying the *Phylloxera vastatrix*, which makes great havoc in the vineyards, to apply hypophosphoric acid dissolved in water. The makers of phosphorus obtain a quantity of this acid in aqueous solution, which is thrown away as waste; but, since the transport of this waste liquid is too costly (it may be very usefully applied where it can be had with ease), the author describes a method of making hypophosphoric acid by the slow combustion of phosphorus. According to his experiments, 2 grms. of this acid dissolved in 10 or 12 litres of water, is a strong poison for all kinds of insects, and not only does not hurt plants, but has the effect of increasing the soluble phosphates in the soil.

Researches on the Improvements to be made on Galvanic Batteries.—M. Delaurier.—A lengthy paper accompanied by several engravings.

Thermo-Electrical Apparatus with Galena and Iron.—MM. Mure, Clamond, and Gaiffe.—According to the results of the experiments described at length, this apparatus deserves the attention of all who require galvanic batteries, since regularity and steadiness of action are here combined with economy and the absence of inconvenient vapours.

Zeitschrift für Chemie von Beilstein, No. 2, 1870.

This number contains the following original papers:—

Sulphotoluide.—MM. Otto and Gruber.—Sulphotoluide, as obtained when its solution in benzol is slowly evaporated, is a beautiful crystalline substance, fusing at about 156°, insoluble in water, difficultly soluble in cold alcohol and ether, and readily soluble in benzol, chloroform, and sulphide of carbon; it is soluble, without decomposition, in fuming nitrous-nitric acid, and is not acted upon when heated to 160° in sealed tubes along with a concentrated solution of caustic potassa in alcohol. Formula—

$$C_6H_4 \begin{cases} CH_3 \\ SO_2 \\ CH_3 \end{cases}$$

Two Isomeric Pentachlorobenzols and Bichlorobenzol-Chloride.—M. Otto.—There exist, says the author, two isomeric pentachlorobenzols, C_6HCl_5. One of these is a needle-shaped, crystalline substance, not soluble in ether or alcohol, even when boiling, but soluble in benzol and chloroform, and melts at about 199°; the other substance of this name is readily soluble, even in cold alcohol, and its melting-point is 85°. Dichlorobenzol-chloride, $C_6H_4Cl_2Cl_6$, is soluble in chloroform.

A New Mode of Formation of Binitronaphthol.—Dr. Balló.—When naphthylamine is treated with nitric acid (sp. gr., 1·35), an energetic action takes place, and the result is the formation of binitronaphthol, according to the following formula:—

$$C_{10}H_7.NH_2 + 3NO_2\,OH = C_{10}H_5''' \left\{ \begin{matrix} (NO_2) \\ OH \end{matrix} \right\} + NO_2.ONH_4 + H_2O.$$

Bulletin de la Société Chimique de Paris, December, 1869.

This number contains the following original papers and communications:—

Studies on the Sewage-Water of Paris.—M. Chevalet.—From this paper, we learn that the portion of the sewage soluble in water (the solid muddy deposit is converted into a kind of dry manure) contains by far the larger quantity of valuable ammoniacal salts, and retains in suspension nitrogenised organic matter, which it is never possible to obtain precipitated; there remains, moreover, similar organic matter in solution. The quantity of soluble ammoniacal salts amounts to 3·371 kilos. to the cubic metre of sewage, and, in addition thereto, it contains 640 grms. of azotised organic matter.

Determination of the Molecular Groups Decomposed by an Electric Current.—M. Bourgoin.—This paper, and the following—

Electrolysis of the Organic Alkalies.—M. Bourgoin—are too lengthy to admit of any useful abstraction.

Revue des Cours Scientifiques de la France et de l'Etranger, Nos. 1 to 7, inclusive (from December 4, 1869, to January 8, 1870).

This collection does not contain, among the very valuable and interesting scientific matters embraced by it, any original paper on chemistry or sciences connected therewith. The last number, however, contains a very extensive review of a book, "Cours de Chimie Inorganique d'Après la Théorie Typique de Gerhardt, par A. Daxhelet, 2 vols. in 8vo. (Paris: Baudry).

Population of Cuba.—From this paper, we learn that the increase of the population of that island has increased to an amount second to that of the increase of the population of the United States, and excepting the latter, more than that of any other part of the world. The present population of Cuba exceeds 2,000,000 inhabitants.

The *Revue* above named contains a great many papers of interest to medical men.

No. 8, 1870.

This number does not contain any original paper relating to chemistry or allied sciences, but we meet here with an excellent physiological paper on the—

Effects of the Climbing of High Mountains upon the Human System.—M. Lortet.

No. 9, 1870.

The Astronomical Observatory at Paris.—The staff of this institution has resigned, and the Minister of Public Instruction will have to choose either to keep M. Le Verrier, and accept the resignation of the whole staff, or accept the resignation of the former, and appoint another director. It appears that very serious dissension has arisen among the parties, giving rise to daily scenes not seemly in a scientific establishment.

Annalen der Physik und Chemie, von Poggendorff, No. 12, 1869.

This number contains the following original papers:—

Thermo-Chemical Researches.—M. Thomsen.—The third instalment of a lengthy paper on this subject, containing the following sections:—Sulphuric acid; selenic acid; sulphurous acid; selenious acid; hyposulphuric acid.

Mineralogical Researches.—M. vom Rath.—The author describes, among other substances, a newly discovered mineral from the neighbourhood of Laach (Rhenish Prussia). This mineral has been named *amblystegite*. It contains, in 100 parts:—Silica, 49·8; protoxide of iron, 25·6; magnesia, 17·7; lime, 0·15; alumina, 5·05; water, 0·5. *Meteorite from Girgenti, Island of Sicily*.—It appears that of this meteorite only very small bits have been obtained in some museums. The author accidentally got a large lump which a friend sent him from Palermo, and thus an analysis became possible, giving, in 100 parts, the following results:—Chrome iron, 1·20; sulphur, 2·24; iron, 3·43; silica, 43·41; alumina, 1·57; magnesia, 26·84; lime, 1.85; protoxide of iron, 17·96; protoxide of manganese, a trace; soda, 1.50.

Crystallographical Description of the Salts derived from Sulpho-Acids of Phenol.—M. vom Rath.—Purely a crystallographical monograph.

Experiments on Dispersion Figures (Zerstreuungsbilder).—M. Bezold.

Vibrations of a Layer of Air corresponding to those of a Fixed Disc.—M. Vierth.

Reply to the Critics of M. Boltzmann.—M. Most.

Experimental Researches on the Effect Heat Exercises upon Electromotive Force.—Dr. L. Bleekrode.—A lengthy monograph of great merit on a subject first investigated by Faraday.

New Sulphur Salts (Third Paper).—M. Schneider.—The author describes:—Potassiumplatinum-sulphoplatinate, obtained by fusing together 2 parts of spongy platinum, 6 of pure carbonate of potassa, and 6 of sulphur. After cooling, the mass is treated with water; what remains undissolved, exhibiting a crystalline appearance and reddish lead colour, accompanied by metallic lustre, is the salt alluded to—

$$\overset{II}{K_2S},\overset{II}{PtS},\overset{II}{PtS},\overset{IV}{PtS}\}PtS_2.$$

Sodiumplatinum-sulphoplatinate—

$$\overset{II}{Na_2S},\overset{II}{PtS},\overset{II}{PtS},\overset{IV}{PtS}\}PtS_2.$$

Potassiumplatinum-sulphostannate—

$$\overset{II}{K_2S},\overset{II}{PtS},\overset{II}{PtS},\overset{IV}{PtS}\}SnS_2.$$

Sodiumplatin-sulphostannate. Disodiumplatinum-sulphoplatinate—

$$\overset{II}{Na_2S},\overset{II}{Na_2S},\overset{II}{PtS},\overset{IV}{PtS}\}PtS_2.$$

Argentumplatinum-sulphoplatinate—

$$Ag_2S,Ag_2S,PtS,PtS\}Pt_2.$$

Thalliumplatinum-sulphoplatinate; this salt, obtained by a rather complex process, is insoluble in cold water; dilute hydrochloric acid extracts all the thallium, without the least evolution of sulphuretted hydrogen; formula—

$$Tl_2S,Tl_2S,Pt_2S,PtS\}PtS_2.$$

Researches on Mica Combinations.—M. Rensch.—A purely mineralogical paper.

Comptes Rendus des Séances de l'Académie des Sciences, January 31, 1870.

This number contains the following papers relating to chemistry and sciences allied thereto:—

Observations on the Process Applied by M. Adams to Produce Deposits of Nickel on other Metals.—M. Gaiffe.—The main gist of this paper is to prove that, whatever may have been the value of the scientific experiments made on the electro-deposition of nickel upon other metals by various scientific men, none of them have succeeded in establishing an industrially-available method for the electro-deposition of nickel upon other metals; and the author states that this part of the discovery is entirely due to M. Adams.

Transformation of Octohedric Crystallised Sulphur into Insoluble Sulphur under the Influence of Light.—M. Lallemand.—It is, the author says, a well-known fact, that M. Schroetter, of Vienna, proved that the action of sunlight converts ordinary phosphorus into red amorphous phosphorus. Sulphur, according to this author, is similarly affected by the direct action of sunlight, inasmuch as the sulphur, previously soluble in sulphide of carbon, and crystallisable, is converted into an amorphous modification insoluble in sulphide of carbon. The author placed a concentrated solution of sulphur in the liquid just alluded to in a sealed tube, and exposed that tube some time to the action of the sun's rays, concentrated by a lens; this causes a copious precipitation of sulphur as an amorphous insoluble matter.

Action of Magnetism upon Rarefied Gases.—M. Daniel.

Heat Evolved when Boron Combines with Chlorine and Oxygen.—MM. Troost and Hautefeuille.—According to the authors, carbon, when combining with oxygen, only gives out 8000 caloric units; boron, under the same conditions, yields 14,400 caloric units; while, when boron combines with 3 equivalents of chlorine, 104,000 caloric units represent the heat set free.

Mode of Division of a Limited Quantity of Acid between Two Bases Applied in Excess.—M. Landrin.—The author has experimented with nitric acid and the oxides of zinc and lead; the average percentage result arrived at is—Oxide of zinc, 29·93; oxide of lead, 20·49; nitric acid, 49·58. As regards the manner of distribution of the nitric acid employed, the author finds that there exists the relation of 1 to 4—that is to say, that, for 1 equivalent of dissolved oxide of lead, there have been dissolved 4 of oxide of zinc.

Electrolysis of Oxalic Acid.—M. Bourgoin.—A lengthy paper on the electrolysis of oxalic acid. The main point of interest is that the group $C_2O_3,3HO$ suffers decomposition only.

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Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 19, 1869.

This number contains the following original papers and communications:—

On Anthracen-Carbonic Acid.—MM. Græbe and Liebermann.—When anthracen is heated, along with liquid phosgen, in sealed tubes, no action takes place until the temperature is raised to 180°, and the full reaction is only obtained by continuous heating to 200°. The result of this operation is the formation of anthracen-carbonic acid, $C_{14}H_9.COOH$; this substance is almost insoluble in cold water, but can be obtained in crystalline state from its boiling-hot solutions in that fluid; the acid fuses at 206°, but loses some of its carbonic acid at 150°. The salts of this acid are soluble in water and alcohol; when the acid is submitted, while in solution in anhydrous acetic acid, to the oxidising action of chromic acid, anthrachinon is formed.

Synthesis of Indol.—MM. Baeyer and Emmerling.—In a lengthy paper, the authors describe the formation of indol, synthetically, from nitro-cinnamic acid, according to the following formula:

$$\begin{array}{lll} & & -CH \\ -CH=CH-COOH & & \| \\ C_6H_4-NO_2 & -CO_2-O_2=C_6H_4 & CH \\ & & | \\ & & -NH \end{array}$$

Azocinnamic acid, obtained by treating nitro-cinnamic acid with sodium amalgam, also yields indol when it is treated with an oxidising substance like, as for instance, peroxide of lead.

Formation of Nitro Bodies (Nitrosokoerpern).—M. Baeyer.—The author states that only such nitrogenous substances as contain the imido group, NH, are capable of yielding, with nitric acid, nitro bodies or compounds. It is further to be observed that only such imido compounds as exhibit a basic character yield nitro derivatives, and quotes, as instances, that, whereas isatine and succinimide do not yield such nitro compounds, diethylamine, diglycolamidic acid, coniine, and other substances do. The paper discusses, at length, the *modus quo* and the origin of these combinations, and the relative position of the nitro group.

Reduction of Angelic Acid to Valerianic Acid.—M. Ascher.—When angelic acid is heated to about 200°, along with hydriodic and amorphous phosphorus, for about eight hours, it is entirely thereby converted into valerianic acid, as was fully proved by the elementary organic analysis of the silver and baryta salts of the last-named acid.

Contribution to the Knowledge of Xylidine Derivatives.—M. Genz.—Starting with perfectly pure xylidine, the author prepared:—Acetxylidide—

$$C_{10}H_{12}NO=\left\{\begin{matrix} C_8H_9 \\ C_2H_3O \\ H \end{matrix}\right\}N,$$

a solid substance, which fuses at about 113°, is readily soluble in alcohol and ether, and capable of crystallisation. Aceto-monobromxylidide—

$$C_{10}H_{12}BrNO=\left\{\begin{matrix} C_8H_8Br \\ C_2H_3O \\ H \end{matrix}\right\}N,$$

also a solid substance. Mexylidine, or dixylyl-guanidine—

$$C_{17}H_{21}N_3=\left\{\begin{matrix} CiV, \\ (C_8H_9)_2 \\ H_3 \end{matrix}\right\}N_3,$$

a solid crystalline substance, difficultly soluble in water, readily soluble in alcohol and ether, combining, with chloride of platinum, to a salt—

$$2(C_{17}H_{21}N_3,HCl).PtCl_4.$$

Appendix to the Contributions on the Products of Desulphuration of Diphenyl-Sulpho-Carbamide.—Dr. A. W. Hofmann.—Too concisely written to admit of useful abstraction.

Relation of Triphenyl-Guanidine to Sulphide of Carbon.—M. Hobrecker.—

$$\underbrace{C_{19}H_{17}N_3}_{\text{Triphenyl-guanidine.}} + \underbrace{CS_2}_{\text{Sulphide of carbon.}} = \underbrace{C_{13}H_{12}N_2S}_{\text{Diphenyl-sulpho-carbamide.}} + \underbrace{C_7H_5NS}_{\text{Pheny essential oil of mustard.}}$$

The reaction proceeds further according to the following formula:—

$$C_7H_5NS+2H_2O=C_6H_7N+H_2S+CO_2.$$

Avogadro's Law, as Derived from the Mechanical Theory of Gases.—M. Naumann.—An algebraico-chemical essay.

On Chloro-Phenol-Sulpho Acid.—M. R. Bähr Predari.—The author describes, at great length, several compounds obtained by him; the chief substance is a potassium salt, $C_6H_4ClKSO_4+2H_2O$, losing, at 110°, its water of crystallisation, fusing at 245°, and becoming decomposed at 300°.

Determination of the Mineralogical Formula of some Mixed Rhombohedrical Carbonates.—M. Cossa.—This paper treats on the question whether, in such substances as dolomite, mesitine, and others, the carbonates of lime and magnesia, and of protoxide of iron and magnesia, are simply mixed or are chemically combined. The paper, however interesting in many respects, is too lengthy and too full of formulæ for useful abstraction.

Incorrectness of the Thermo-Chemical Estimations and Researches made, by means of the Mercurial Calorimeter, by MM. Favre and Silbermann.—M. Thomsen.—Chiefly a series of tabulated formulæ and figures.

Methods of Distinguishing Molecular Compounds.—M. Rathke.

Molecular Weight of some Protoxide Combinations.—M. Ladenburg.

Third Paper containing the Results of the Researches on the Ethereal Derivatives of Acids and Alcohols.—M. Henry.—Among a series of different products, the author describes, chiefly, monochloro-methylphenol, $C_6H_4Cl(CH_3O)$, a very mobile fluid, insoluble in water and in caustic alkaline liquids; soluble in alcohol and ether; sp. gr. at 9°, 1·182; boiling-point 200°. Monochlorethylphenol, $C_6H_4Cl(C_2H_5O)$, also a liquid, boiling at 210°; sp. gr. at 9°, 1·106. Monobromo-methyl-phenol, $C_6H_4Br(CH_3O)$, a liquid boiling at 220°; sp. gr. at 9°, 1·494.

Some Reactions of Anhydrous Sulphuric Acid, and a New Method of Formation of Oxysulphide of Carbon.—M. Armstrong.—After referring to the labors of MM. Schützenberger, Rose, and Williamson on this subject, the author describes a series of experiments made with anhydrous sulphuric acid and sulphide of carbon, equivalent parts of which substances having been mixed and heated on a water-bath, give rise to the formation of oxysulphide of carbon and sulphur, according to the following formula:—

$$CS_2+SO_3=COS+SO_2+S.$$

Specific Heat of Gases, and the Correct Capacity for Heat.—M. Horstmann.—An algebraico-physical monograph.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, November and December, 1869.

These two papers, published together, contain the following original papers and memoirs:—

Detection and Estimation of Arsenic in the Rosaniline (Fuchsine) of Commerce.—Dr. Riecker.—This very lengthy paper is essentially devoted to the testing of the correctness of the methods for the quantitative estimation of arsenic, and the possibility of the quantitative estimation of arsenious and arsenic acid separately, when both these substances are present. As regards the qualitative detection of arsenic in fuchsine, the author states that the pigments of that name tested by him, and obtained from various sources, all contain arsenic in some form or other. That this quantity is not small may be inferred from the results of the author's quantitative analysis, from which we gather that a sample of fuchsine obtained direct from a manufacturer contained, on an average, 2·073 per cent. of arsenious acid and 7·593 per cent. of arsenic acid. Another sample, obtained from a wholesale drysaltery, contained, on an average (several analyses were made), 1·108 per cent. of arsenious acid and 4·4705 of arsenic acid. This research was undertaken with the express view of testing the question, whether the use of fuchsine, as a coloring matter for syrups, sweetmeats, and the like, is or is not to be prohibited, as can be done in Prussia by a simple police order. It is quite evident that fuchsine should not be indiscriminately used for such purposes.

Easy Method of Removing Gypsum from Water.—Dr. Riecker.—The use of witherite, native carbonate of baryta, is recommended by the author to remove all the gypsum from water. Of course the quantity of the mineral to be applied for this purpose should be regulated according to the quantity of gypsum present in the water; but, as an instance, we may state that a water containing, in 10,000 parts, 4·37 parts of gypsum, requires about ½ lb. of witherite, ground to a fine powder, for every large pailful of that water. After the addition of the witherite, the water is well stirred, and next left at rest to deposit the sediment for twenty-four hours, and then run off for use. The water may be either boiled before or after this process, and will be found quite soft.

Proper Arrangements of Pumps so as to Yield a Pure and Wholesome Potable Water.—Dr. Riecker.—Attention is called to the necessity of excluding from pumps any surface, or drainage, or sewage waters, and to bore the wells to such a depth as to be out of the reach of such contaminations of the water to be used for domestic and industrial purposes.

Cosmos, February 5, 1870.

Investigation of the Grotto of Montesquieu-Avantes (Ariege, France).—M. Regnault.—The researches made by this author of the locality alluded to, lead him to agree with MM. Vogt, Broca, Strenstrup, and other *savants*, as to the anthropophagie nature of primeval man.

Atmospheric Electricity of Haiti.—M. Ackermann.—The island of St. Domingo, as it is also called, is situated between 17° 53′ and 19° 58′ N. latitude, and between 70° 45′ and 76° 55′ latitude W. from Paris. According to the author, who has, during a series of five years, made meteorological observations at Port au Prince, there have, on an average, been 129 days of each year either severe thunderstorms, or other very marked electrical phenomena, especially during the months of May, July, August, and September. Severe thunderstorms more frequently occur during day- than night-time. The year 1868 was especially remarkable for severe thunderstorms; during one of these, lasting for forty-five minutes, 400 lightning flashes were distinctly seen.

Pharmaceutische Zeitschrift für Russland, November, 1869.

This number contains the following original papers and memoirs relating to chemistry:—

Monograph on Inuline.—Dr. Dragendorff.—Continued from former numbers. This exhaustive paper is not yet ended.

Preparation of the Amides of Polybasic Acids.—Dr. Lösch.—The author prepared tartramide, citramide, and succinamide, by causing liquid ammonia to act upon the ethers of the acids referred to. The chief result of the author's researches on this subject is that, by the action of liquid ammonia (in aqueous solution), just alluded to, the neutral amides of the acids are only formed for a moment; but decomposition sets in, and other compounds result from the reaction, and it is, therefore, necessary to act upon the ethers referred to with an alcoholic solution of ammonia-gas when it is desired to obtain the amides of the acids.

Artificial Kirschwasser.—M. Reinsch.—The genuine alcoholic fluid of this name owes its flavour to the presence of a small quantity of hydrocyanic acid and ethereal oil of bitter almonds (hydruret of benzoyl). The author suggests that, when a certain quantity of the young leaves of the peach tree (a handful is named) is beaten up in a porcelain mortar, next digested with 4 litres of water during two days, and this mixture added to 2 litres of strong alcohol (94 per cent), and submitted to distillation, and the distillate diluted with water to a strength of 60 per cent alcohol, a fluid is obtained fully equal in taste and aroma to the best Swiss kirschwasser made from cherries bruised up with the stones and kernels they contain. The author cautions against the drinking of too large quantities of this liquor; and so he may, since cases of accidental poisoning with this and similar alcoholic liquors (Persico among the number) are by no means rare.

Moniteur Scientifique, No. 315, February 1, 1870.

This number contains the following original papers relating to chemistry and subjects allied thereto:—

Direct Application of Wool-Suint (Fatty Matter containing a large quantity of Potassa Salts) to the Preparation of Prussiates and Cyanides.—M. Havrez.—Suint contains some 40 per cent of potassa; and, when previously ignited, this alkali becomes thereby intimately mixed with strongly-nitrogenised animal charcoal. The author chiefly points out the profit to be derived from the use of suint for the manufacture of prussiates and cyanides, and to the paper is added a short report from M. Schattenmann, prussiate and cyanide manufacturer, at Bouxwiller, near Strasburg, who states that results of experiments made with suint by him, on the large scale, are decidedly favourable to the use of that substance for the purpose alluded to. It should be observed that the quantity of suint contained in raw wool amounts to one-third of its weight; and the author states, in a foot-note, that, since in 1867 there was imported into the United Kingdom 63,000,000 of raw wool from the Cape and Australia, the quantity of suint contained therein amounted to at least 20,000,000 kilos.

Latent Heat of Volatilisation of Liquids.—M. Koehler.—An algebraico-physical treatise.

Artificial Alizarine.—M. Kopp.—The author points out that there are at present several processes of preparation of alizarine by artificial means, which are entirely different from each other. After mentioning MM. Græbe and Liebermann, and Gutzkow and Broenner, the author

states that Dr. Grieff, at Cologne, has just come forward with an entirely new process, which will be tried on the large scale by MM. Weiler and Co., of that city. Reference is made to the fact that the purified alizarine (artificially made by MM. Meister and Lucius) yields, on elementary analysis, in 100 parts—Carbon, 69·92; hydrogen, 3·34; oxygen, 26·74. The formula $C_{14}H_8O_4$, by some assigned to alizarine, requires, percentically—C, 70·00; H, 3·33; O. 26·67. The author enters, at some length, into the question, whether artificially-made alizarine, even if it be cheaply and abundantly produced, will prove, in all respects, a suitable substitute for madder, and comes to the conclusion, for good and sound reasons (too many to quote here, but which we fully endorse), that the very composition of madder is such as to ensure its continued use, and even preference above any of its single tinctorial elements, because the effects produced by madder and its commercial preparations are due to the joint action of all its tinctorial and some one or more of its other constituents.

Soluble Iodine Green.—MM. Kalle and Co. write from Biebrich, Nassau, Prussia, stating that they have succeeded in producing an iodine green soluble in tepid, and even cold water, without difficulty. This new material, moreover, does not contain picric acid, and, being less acid, does not require silicate of soda, for which borax is to be substituted. This dye yields so fast a colour that woollen tissues can be fulled after dyeing with it.

Polytechnisches Journal von Dingler, first number for December, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Experiments made with the view to Determine Percentically the Value of Fire-Clays.—Dr. Bischoff.—In a lengthy paper, the author records a series of pyrometric experiments made with the view of ascertaining the value of such substances as pure silica, alumina, and mixtures of the same, in respect to resistance of fusion, and, also, of various native mineral products, known by different names and of very different mineralogical and chemical characters.

Second number for December, 1869.

Preparation of Ferricyanide of Potassium, or Red Prussiate.—M. Reichardt.—The author recommends the use of bromine, instead of the usual application of chlorine, to convert the ferrocyanide of potassium (yellow prussiate) into ferricyanide. 422·28 grms. of crystallised ferrocyanide require 79·97 = 80 of bromine = 100 : 19 = *circa* 6·33 c.c. The formula is—

$$2(2KCy + FeCy + 3HO) + Br = 3KCy + Fe_2Cy_3 + KBr.$$

Experiments made, on the small scale, with 50 grms. of ferrocyanide, proved that 9·5 grms. of bromine were required; and the operation is very rapidly finished. The author states that experiments made on the large scale answer exceedingly well.

Chemical Analysis of a Sample of Extract of Meat.—M. Reichardt.—This sample was prepared by a private firm, and yielded, on analysis, the following results:—Portion soluble in alcohol (of 83 per cent strength), 80·76 per cent; water, 16 per cent; fatty matter, 0·2 per nitrogen, 9·99 per cent; ash, 21·36 per cent (containing potassa, 9·0 per cent; soda, 2·3 per cent; phosphoric acid, 6·1 per cent. These results, as compared with Liebig's and the Fray Bentos extracts, are stated by the author to be in favour of the extract tested by him for MM. Buschenthal and Co.

First January number, 1870.

Substances Suitable to Agglutinate Coal-Dust.—M. Jicinsky.—This paper is a valuable contribution to the proper methods of utilising coal- and coke-dust and small coals, and the manufacture of artificial fuel, but cannot be understood without reproduction of the engravings.

Analysis of Pig-Iron.—M. Richter.—The sample was obtained from a peculiar iron ore met with in Silesia. The sp. gr. of the iron = 7·361. It contained in 100 parts:—Iron, 90·041; copper, 5·343; cobalt, 0·666; nickel, a trace; arsenic, 0·013; silicium, 1·644; phosphorus, 1·464; sulphur, 0·404; combined carbon, 0·723; no molybdenum.

Revue Hebdomadaire de Chimie, January 20, 1870.

Analysis of Some Extracts of Meat as met with in Commerce.—M. Lebaique.—The number above quoted contains the results which we reproduce here; but a full account of the method of analysis employed is recorded in two previous numbers—viz., those of December 23rd and 30th. The author distinguishes the extracts by the figures A, B, C, D, and E, referring, respectively, to—Liebig's meat extract; La Plata extract; extract from M. Tooth, Sydney; extract of French Company in South America; extract of M. Whitehead, Sydney. Organoleptic, or physical properties of the extracts:—A. A firm, homogeneous, yellow-coloured substance, perfectly soluble in water, yielding a brown-coloured solution, and exhibiting a strongly-pronounced smell as well as taste, contains 7·5 per cent of water, 61·2 per cent of substances soluble in alcohol, 23 per cent of ash, and a total of 9 per cent of nitrogen.—B. (Two samples.) No. 1 is a somewhat soft, homogeneous, brown-coloured substance, imperfectly soluble in water (insoluble residue amounts to 2·5 per cent); the aqueous solution is brown-coloured, and exhibits a strong animalised smell and taste; it contains 9·0 per cent of water, 53 per cent soluble in alcohol, 21 per cent of ash, and a total of 9 per cent of nitrogen. No. 2 is a soft, brown-coloured, homogeneous substance, soluble in water, without residue, brown-coloured solution, odour and taste rather strong; it contains 16 per cent of water, 53 per cent soluble in alcohol, 18 per cent of ash, and a total of 9·6 per cent of nitrogen.—C. A soft, light brown-coloured, non-homogeneous substance, only imperfectly soluble in water (insoluble residue, 3 per cent); the aqueous solution is light brown-coloured, and odour and taste are rather strong; it contains 15 per cent of water, 54 per cent soluble in alcohol, 21 per cent of ash, and a total of 8·4 per cent of nitrogen.—D. A hard brown-coloured granulous substance, imperfectly soluble in water (1·5 per cent of insoluble residue); colour of aqueous solution, bright brown; taste and odour less strongly marked than that of the other samples; it contains 16·5 per cent of water, 28 per cent of matters soluble in alcohol, 9·5 per cent of ash, and a total of 10·7 per cent of nitrogen.—E. A soft, homogeneous, light brown-coloured substance, soluble in water without leaving any residue; colour of solution brown; smell and taste, rather strong; it contains 17 per cent of water, 47 per cent of matter soluble in alcohol, 19 per cent of ash, and a total of 9·46 per cent of nitrogen. The alcohol applied contained 90 per cent of absolute alcohol.

Chemical Investigation of the Apples suitable for Cyder Making.—M. Mène.—It appears that there has been held, at St. Lô (Brittany, France), a mixed congress, of scientific men and agriculturists, who have investigated this subject. The method of analysis, and the divers means employed to ascertain the following particulars, viz., sp. gr. of the juice, dry glucose, dry mucilage, tannin, free malic acid, divers malates, and water, are given at great length; and a tabulated form records the results obtained by the analysis of some twenty-four kinds of apples, stating the constituents for 1000 parts. The lowest sp. gr. of the juice has been found at 6·5, the highest at 11·7; smallest quantity of glucose, 122·0, highest, 194·0, for 1000 parts.

New Reagent for the Estimation of Carbonic Acid in Combination in Bicarbonates and in Natural Waters.—M. Lory.—The author employs phosphate of copper dissolved in a very slight excess of hydrochloric

acid; the phosphate of copper is obtained by precipitating a solution of bichloride of copper with ordinary phosphate of soda. The precipitate is collected on a filter, well washed, and, after having been taken from the filter, suspended in water and dissolved by the addition of a few drops of hydrochloric acid. When this reagent is added to any water containing alkalies or alkaline earths in the state of carbonates or bicarbonates, the result is, at first, the formation of a bluish coloured cloudiness, or turbidity; by the addition of a larger quantity of this reagent, this turbidity disappears, and the liquid becomes clear again. This point having been reached, the quantity of the reagent applied will be proportional to the total equivalent of the bases present, and, consequently, to the carbonic acid which was combined with these bases. In order to titrate the reagent, dissolve 0·265 grm. (equal to 1-200th equivalent) of perfectly pure and dry carbonate of soda in water, and saturate this solution with carbonic acid, in order to convert it into bicarbonate (excess of carbonic acid does not at all affect the reagent). 4·4 c.c. of this solution upon 1 decilitre of pure water should produce, by the addition of the copper liquor, the reaction already alluded to, and these 4·4 c.c. correspond to 0·220 grm. of carbonic acid.

January 27, 1870.

Manufacture of Hyposulphite of Soda with Alkali Waste.—M. Mène.—Sulphate of soda is added to the alkali waste, which is spread out in regularly-formed heaps, or beds, and this mixture is left to the action of atmospheric air; the soda-salt alluded to is decomposed, and there is formed a large quantity of hyposulphite, which makes its appearance in the shape of efflorescences. When this has increased to a certain point, the mass is treated with water, and the aqueous solution is next treated with a weak acid, in order thereby to eliminate salts of lime and some sulphides. This latter operation also produces sulphur, since the sulphuretted hydrogen which is given off may be utilised.

Useful Application of Mica.—M. Mène.—In Germany, the doors of the steam-boiler furnaces are now very generally provided with square pieces of mica, properly fastened, by means of which the fireman is enabled to observe the fires without the necessity of opening the furnace doors too frequently, which is injurious, on account of interfering with the draft and proper course of combustion of the fuel, by reason of the access of irregular currents of cold air. Mica withstands a very high temperature, and the accidental breakage of these squares, or panes of this substance thus inserted is guarded against by a properly-constructed iron wire-guard outside.

Electrical Pyrometer.—M. Becquerel.—Without reproduction of the cuts, this paper is not available for abstraction.

Les Mondes, February 3, 1870.

Artificial Caoutchouc.—M. Granier.—This material is a mixture containing gelatine and a variety of other substances (not specified) producing a homogeneous elastic substance, insoluble in mineral, as well as vegetable essential oils; not acted upon, moreover, by either coal or other hydrogenised gases This material is now employed in France for a variety of purposes, too many to be here enumerated; its cost is only 3 francs per kilo.; and it melts readily at 100°, without decomposition, and can be cast into different moulds. Neither cold nor heat affect this substance, which, when completely oxidised, becomes more infusible than vulcanised caoutchouc.

Crystallisation of Diamond, Rock-Crystal, and Tribasic Phosphate of Lime by means of Cold.—M. Collas.—The author begins his paper with the following statement:—"The last of the subjects just mentioned is an accomplished fact; the second (speaking of rock-crystal) has been only half attained; and the first is, as yet, a hypothesis." The gist of the paper, which contains a lengthy description of experiments, may be summarised as follows:—The hydrate of the basic phosphate of lime becomes horny by desiccation, pulverulent on being boiled, and crystalline by congelation. The precious-stones, which contain cavities filled with a liquid, are crystallized hydrates, and the liquid alluded to is a remnant of the water of the hydrate. A hydrate crystallises in a manner different from that of the crystallisation of a saturated saline solution. The crystallisation of a hydrate by cold (freezing) is a dissociation; the hydrated substance precipitates entirely in crystalline state. Lastly, the author states that it is a contradiction, so to say, to try to obtain crystallised carbon (diamond) by means of heat. The author's opinion concerning this crystalline carbon is that, at a very remote period of the existence of our globe, hailstorms of diamonds have taken place. And to the paper a map is added indicating, by means of a curved line, the *cercle diamantaire* —*i.e.*, the area within which diamonds are now to be found. Graphite is, according to the author, destroyed diamond—that is to say, diamond which has lost its crystalline state.

Pre-Historic Man.—M. Capellini—The author has explored a grotto in the island of Galmeria, Italy, and found human and animal bones, mixed up with flint instruments, and several objects undoubtedly made by men. This grotto is so situated as to make its exploration not only difficult, but dangerous; yet it appears, according to the author, to have been inhabited, since traces of a fire-place were discovered therein.

Comptes Rendus des Séances de l'Académie des Sciences, February 6, 1870.

This number opens with a brief communication on a subject which, though not belonging to chemistry, we cannot refrain from quoting, viz.:—

Extraordinary Fall of Snow at Collioure, Pyrences Orientales, France.—Ch. Naudin.—Collioure is situated on the Mediterranean, in latitude 42° 32′ N. The author states that the prevailing temperature, up to the 17th of January, had, as usual, ranged from +11° to +17°C.; it then fell gradually, and on the 21st ult., while at −0·8°, a fall of snow commenced, which continued for 44 consecutive hours. A few of the oldest inhabitants remember a similar phenomenon taking place in the year 1804; very few, however, have ever witnessed such a remarkable occurrence. The average depth of the snow amounted, in open spaces, to from 80 to 120 centims., but in some parts it accumulated to a depth of nearly 1·5 metres (fully 5 ft.); the temperature at this time was about −1°. Among the very noticeable points, the author speaks of the palm trees, which were literally flattened down, as plants are in an herbarium; but, curiously enough, notwithstanding some of them have been for ten or twelve days in a mass of ice and snow, they have suffered very little, compared with the orange, lemon, and olive trees, most of which are destroyed. The author, therefore, calls particular attention to this fact, because geologists have drawn conclusions as to climate from the discovery of palm trees in the miocene strata; and it appears to him that the facts observed at Collioure prove (though isolated) that these plants might actually stand a severer winter climate than is usually believed, while they also point out that the causes of the death of plants in winter are more complex, and not simply due to a certain degree of cold only.

Proof of the Destruction of the Chemical Type when Substitution Takes Place.—E. J. Maumené.—This lengthy paper is chiefly devoted to prove a peculiar theory which the author holds. The paper is too lengthy for useful abstraction.

On Thermo-Electricity.—J. Delaurier.—The author says—"I have proved the existence of metals and other bodies which are by themselves thermo-electric, and these

I call active bodies. The production of electricity is not due to the two metals which are soldered or joined together, since a non-active metal is only a carrier of the electricity developed by heat in the active body. The cause and direction of the current depend chiefly upon the molecular structure of the active body. Heat is converted into electricity by preference in those substances which are relatively better conductors of electricity than of heat. There exist solid bodies which possess the property of yielding as much electricity as hydro-electric elements; among these, tellurium and iron pyrites stand foremost."

Observations on the Zodiacal Light and Aurora Borealis at Munster, Westphalia (Prussia).—M. Heis.

Simplification of the Construction of Holtz's Electrical Machine, and Determination of the Relation between the Dynamical Work Done and the Quantity of Electricity Produced.—E. Bouchotte.—A lengthy memoir on this subject.

Heat Evolved when Silicium Combines with Chlorine and with Oxygen.—L. Troost and P. Hautefeuille.—This paper is a continuation of one on the same subject, by the same authors. In this very lengthy memoir amorphous silicium is treated. The heat disengaged by the combination of 1 grm. of this amorphous body with oxygen is 7830 units; with chlorine, 5630. When 1 grm. of chloride of silicium reacts upon 140 times its weight of water, it is 2915; the heat disengaged when 1 grm. of amorphous silicium is converted into crystallised silicium is 290 units of heat. When taken by equivalents, these quantities become, respectively:—

	For Si = 14.	For Si = 21.
With oxygen	109,620	164,430
With chlorine	78,820	118,230
When the chloride reacts upon 140 times its weight of water	40,820	61,220
When conversion from amorphous to crystallised	4,060	6,090

There is added to this paper a very interesting, but, unfortunately, too lengthy discussion on certain phenomena observed in the Bessemer and other metallurgical processes of iron manufacture.

New Method of Synthesis of Organic Acids.—M. Berthelot.—Reserved for full translation.

Simultaneous Formation of Isomeric Substances in Definite Proportions.—A. Rosenstiehl.—The author refers to his former researches on this subject, and treats, in this memoir, a rather intricate matter, the main gist of which is, that not (as has been stated by several chemists) three, but only two, isomeric toluens are formed when nitric acid acts upon the toluen obtained from coal-tar.

Nature and Origin of the Blood Globules.—MM. A. Béchamp and A. Estor.

Present State of the Volcano of Santorin.—M. Goreeix.

Presentation of Valuable Manuscripts.—M. Bontemps.—This gentleman has handed over to the Academy the very valuable collection of manuscripts left by the late Prof. Charles, whose name is connected with the first experiments of the use of hydrogen, in the year 1783, for the purpose of filling air balloons. The deceased was, in his day, a physicist of celebrity; and his lectures on experimental natural philosophy are well known. The Academy has accepted the offer made by M. Bontemps, who had obtained these papers in consequence of his father having been Prof. Charles's friend and one of the executors of his will.

Journal de Pharmacie et de Chimie, January, 1870.

This number contains the following original papers relating to chemistry:—

Transformation of the Hydrate of Chloral into Chloroform in the Animal Body.—M. Personne.—A physiologico-chemical essay.

Researches on the Electrolysis of Organic Alkalies, or Alkaloids.—M. Bourgoin.—The author, in order to illustrate his subject, begins by explaining the action of an electric current upon perfectly pure and neutral sulphate of ammonia—

$$SO_3NH_4O = \underbrace{(SO_3+O)}_{\text{Positive electrode.}} + \underbrace{(NH_4)}_{\text{Negative electrode.}};$$

and next at the positive electrode, $(SO_3+O)+3HO=SO_3\,3HO+O$, and at the negative electrode, $NH_4=NH_3+H$. The author next describes, at length, a series of experiments made with neutral sulphate of atropine, the acid sulphate of atropine, neutral sulphate of brucine, the acid sulphate of brucine, and the neutral and acid sulphates of codeine and quinine. The conclusions to be drawn from these experiments may be summarised as follows:—The electric current decomposes the salts of alkaloids in the same manner as it acts upon sulphate of ammonia—that is to say, the basic element reconstructs the alkali at the negative electrode, and the rest of the elements of the salt is set free at the positive electrode. When the solution is acid (not readily so when it is neutral), the positive liquid assumes a colouration which is precisely the same as that which nitric acid yields, but is entirely independent of the formation of any nitrated compound. The gas given off at the positive electrode contains not only oxygen, but also carbonic acid and oxide of carbon, often in equal bulks. There are, beside these gases, various other products formed (especially ammoniacal compounds)—the result of the splitting up of the alkalics which are gradually burnt up by the action of the oxygen, which action is the more energetic the more acid the solution contains.

Researches on Bromide of Potassium: its Best Preparation and Composition when Pure.—M. Adrian.—This paper contains the results of analyses of ten samples of bromide of potassium, from which we condense the following points:—The quantity of water interposed (water of decrepitation) between the crystals varied from 4 to 0·5 per cent; the quantity of free, or carbonated alkali, not combined with the haloid, varied from 4 to 1·5 per cent; the quantity of iodide of potassium (contained only in three out of the ten samples), varied from 2 to 0·5 per cent; the quantity of bromide of potassium varied from 91·60 to 62·80 per cent (average of ten samples, 83·67 per cent); chloride of potassium varied from 3·5 to 30·07 per cent; sulphate of potassa varied from 0·90 to 3·30 per cent; while, of bromate of potassa, traces were present in all, and an appreciable quantity in one sample.

On Mustard.—M. Commaille.—A lengthy memoir, compiling what is known of the chemical constitution and properties of mustard, and its pharmaceutical uses.

Annalen der Chemie und Pharmacie, January, 1870.

This number contains the following original papers and memoirs:—

On Fermentation, and on the Source of Muscular Force.—Dr. Justus von Liebig.—This paper is the first instalment of a series to be continued. The section title to this memoir is "Alcoholic Fermentation;" we regret that it is not possible here to enter into any details of this memoir, which deserves full translation.

Contribution to our Knowledge of the Bases Contained in Opium.—M. Hesse.—After referring to the labours of M. Merk, and his own former researches on this subject, the author describes meconidine, lanthopine, and laudanine. Meconidine, $C_{21}H_{23}NO_4$, is a rather readily decomposable compound in the presence of strong acids, and especially when heat is simultaneously applied; this

base yields salts with difficulty, and these compounds are very unstable. Laudanine is readily soluble in benzol and chloroform, also in boiling alcohol, but difficultly soluble in ether and alcohol when cold; this base, although tasteless by itself, yields, with acids, very bitter salts; fuses at 165°; formula, $C_{20}H_{25}NO_3$; yields salts with acids, well-defined chemical compounds. Lanthopine, $C_{23}H_{25}NO_4$; this substance is best soluble in chloroform, difficultly so in alcohol, ether, and benzol; it yields, with acids, salts. Thebenine, $C_{19}H_{23}ClO_6$ (formula of the hydrochlorate of this base), is an amorphous substance, and rather prone to decomposition.

Treatise on the Urea Compounds. — M. Menschutkin.—First part: The Ureides. Section 1: Action of Cyanate of Potassa upon the Amido Acids, and the Derivatives therefrom.—Oxybenzuramic acid—

$$C_6H_4[NH(CO.H_2N)].CO_2H;$$

oxybenzoyl-urea—

$$C_6H_4[N(CO.H_2N)].CO;$$

oxybenzuramide—

$$C_6H_4[NH(CO.H_2N)].CO.H_2N;$$

anisuramic acid—

$$C_6H_3[NH(CO.H_2N)](CH_3O).CO_2H.$$

Space forbids us to quote more formulæ, with which the treatise abounds.

On Dichlorobromohydrine, and its Decomposition by Hydrate of Baryta.—M. Claus.—The main object of this paper is the vindication of the correctness of the author's labors on the subject, somewhat impugned by other labourers in the same field.

Some of the Combinations of the Toluol Group.—MM. Limpricht and Schwanert.—Second paper on this subject, treating chiefly of:—Oxytolidens, $C_{14}H_{10}O_2$, solid substances, readily soluble in ether and boiling alcohol, fusing at 172°, and subliming without decomposition; bromoxytolidin, $C_{14}H_9BrO_2$, an oily fluid; bibromoxytolidin, $C_{14}H_8Br_2O_2$, a solid substance, soluble in ether, sulphide of carbon, and boiling alcohol; chloroxytolidin, $C_{14}H_9ClO_2$, a solid crystalline body, soluble in ether, benzol, and boiling alcohol, also in glacial acetic acid, and fusing at 57°; trichloroxytolidin, $C_{14}H_7Cl_2O_3$, a solid body, fusing at 87°, and soluble in benzol, ether, hot alcohol, and hot glacial acetic acid; pentachloroxytolidin, $C_{14}H_5Cl_5O_2$, readily soluble in benzol and boiling glacial acetic acid, difficultly soluble in ether and alcohol, and fusing at about 189°.

Preparation of Lepiden from Thionessal.—M. Berlin.—The author heated thionessal with HCl and chlorate of potassa, and the purified product of this reaction was again heated in a sealed tube with hydriodic acid, to 140°; the resulting product gave, after purifying and recrystallisation, lepiden, $C_{28}H_{20}O$.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 204, December, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

We briefly call attention to two reports, the subjects of which, although not related to chemistry, deserve a passing notice:—

Report on a Printing Stenographic Apparatus Invented by M. Bryois.

Report on the Means of Saving Life in Cases of Fire in Dwelling-Houses and High Buildings.—M. Charrière.—This excellent report is illustrated with woodcuts, and deserves the attention of all whose dwelling-houses and places of abode are at some elevation above the level of the streets.

Alkaline Lakes of California.—M. Phillips.—It appears that a portion of California is very rich in mineral waters, and, moreover, contains large sheets of water, evidently occupying the craters of extinct volcanoes. The water of Lake Owen has a sp. gr. of 1·076, and contains 7128·24 grs. of solid matter to the gallon, consisting of 2942 grs. of chloride of sodium, 956 grs. of sulphate of soda, and 2914 grs. of carbonate of soda; while the rest is composed of sulphate and phosphate of potassa, silica, and traces of organic matter. On the banks of this lake, an incrustation occurs, of yellowish white color; this substance gave, on analysis, in 100 parts—Chloride of sodium, 2·14; sulphate of soda, 3·10; carbonate of soda, 46·10; silica, 0·22; traces of potassa; and 48·44 of water and organic matter. The Kaysa, or borax lake, yields, daily, 3000 lbs. of crude borax, composed, in 100 parts, of—Dry biborate of soda, 51·85; water of crystallisation, 45·44; insoluble matter, 1·42; dry sulphate of soda, 0·05; chloride of sodium, 0·08; phosphate of soda, 1·15. The water of this lake has a sp. gr. of 1·0274, and contains, of the following substances, the quantities thereby quoted in grains to the imperial gallon:—Chloride of sodium, 1198·66; chloride of potassium, 9·92; iodide of magnesium, 0·22; bromide of magnesium, a trace; carbonate of soda, 578·65; biborate of soda, 281·48; phosphate of alumina, 3·52; sulphate of lime, traces; silica, 2·37; matters volatile at red heat, 238·66. All the salts are calculated in the anhydrous state. The mud of this lake contains large quantities of crystallised borax; at some short distance from this lake, a rich sulphur deposit is met with, which contains, also, a vein of cinnabar; both these minerals are now worked. The quantity of sulphur daily obtained amounts to some 7 tons' weight.

Mining, and some other Industries of Russia.—This empire contains 1043 gold mines, which, in 1866, produced 26·5 tons of pure gold; only 18 tons of silver were produced; the quantity of platinum was 1712 kilos.; and of copper, 4320 tons were obtained. The 262 beet-root sugar works produced, in 1867, 70,000,000 kilos. of sugar; while, during the same period, 382,000 metrical quintals of tobacco were grown.

Official Instruction concerning the Keeping and Use of Nitroglycerine.—The Chief Inspector of Mines at Dortmundt, Prussia, while sanctioning the use of this material for blasting purposes, has laid down excellent rules for its safe keeping and management, which deserve attention, and may be usefully applied wherever this explosive substance is employed.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 3, 1869.

Among the record of the labours performed at the Chemical Laboratory of this Institution, we meet with a lengthy series of minute analyses of braunkohlen. Kaolin from Budweis—Silica, 48·6; alumina, 43·0; peroxide of iron and magnesia, a trace; water, 8·2. Fire-clay from Biharer (Hungary)—Silica, 60·3; alumina, 28·0; lime, 0·5; water, 10·5. Porcelain clay from Mahrenberg (Styria) Silicate of alumina, 87·6; alumina soluble in HCl, 5·5; magnesia, 2·1; water, 4·6. Iron ore from the Josephsthal iron ore quarries—Insoluble in HCl, chiefly quartz, 61·8; peroxide of iron, 30·5; lime, 8·0; magnesia, a trace; yield of metallic iron, 21·3 per cent. Crude carbonate of potassa from Czernowitz—Insoluble in water, 0·1; carbonate of potassa, 58·0; carbonate of soda, 2·1; sulphate of potassa, 14·2; chloride of potassium, 3·1; water, 23·2. The Director of this Laboratory, Dr. Karl Ritter von Hauer, states that the water was taken up hygroscopically.

Les Mondes, February 10, 1870.

This number opens with a lengthy paper on the—

Imperial Observatory.—M. Moigno.—The main gist and aim of this paper is a review of M. Le Verrier's career

as Director of the Observatory, a situation from which that gentleman has been relieved by a recent imperial decree.

Artificial Construction of Mineral Springs.—M. Rouby.—There is a woodcut annexed to this paper which renders its proper understanding an easy matter. The affair is, however, simple enough, since the contrivance (applicable only in the country, and requiring, moreover, a hilly region) consists of a subterranean water-tight tank, covered on the top with divers layers of minerals, through which the rain-water is made to pass; and this, while trickling down, dissolves a portion of the mineral matters, and enters, thus charged therewith, the tank, from which an exit-pipe leads it to the place of consumption.

Solar Electricity.—M. Marco.

Syphon Pumps and Suction Syphon.—M. Lagillardais.—A good paper on applied hydrodynamics, illustrated by woodcuts.

Improved Photometer for taking Positive Carbon Proofs.—M. Marion.—Illustrated by a cut.

Labour of Children in Manufactories.—Dr. Decaisne.—An interesting account of a large establishment at Lyon.

Annales de Chimie et de Physique, December, 1869.

The only original paper contained in this number is a brief optico-physical description of a—

New Micrometer.—M. Soleil.—Not suitable for abstraction.

Revue des Cours Scientifiques de la France et de l'Etranger, No. 10, 1870.

Contains nothing relating to chemistry or allied sciences.

February 12, 1870.

Banquet to Dr. A. W. Hofmann at Berlin.—The German Chemical Society, having elected Dr. Rammelsberg as their President for this year, have entertained their late President, Dr. A. W. Hofmann, at a splendid and sumptuous banquet, presided over by Prof. Magnus. Among the large number of guests, we name Dr. R. Virchow, Prof. Dove, Prof. Rose, Dr. du Bois Reymond, His Excellency the Right Hon. Mr. Bancroft, the United States Minister at Berlin, and a very large number of *savants* from Berlin and other parts of Germany. Many of the foreign members sent telegrams of felicitation, and among these the following was received from M. J. Dumas, Paris:—"Your festive meeting is heartily shared by all chemists of the world who admire and cherish you." Just before the meeting broke up, there was distributed a photo-lithograph representing Dr. Hofmann under the emblem of Jupiter Ammon (typifying his researches on ammonium), with an aureola of aniline colours. A large number of toasts were heartily responded to; and an ode to aniline, composed for the occasion, caused general applause and great merriment.

American Journal of Pharmacy, January, 1870.

Among a great deal of strictly pharmaceutical matter, this number contains the following original papers relating to chemistry:—

Contribution to Our Knowledge of the Chemical Composition of Gelsemium Sempervirens.—Dr. Wormley.—The author made a series of experiments with the fluid extract of gelsemium, and has discovered therein a new organic acid and a new alkaloid—the former having been denominated gelseminic acid, and the latter gelseminine. The preparation and properties of these are described at very great length. In pure state gelseminic acid is a colourless, odourless, nearly tasteless, solid crystallisable substance, sparingly soluble in water, more soluble in hot water, and freely soluble in ether and chloroform; the substance is a strong acid, completely neutralising bases, and forming salts, which, excepting those of the alkalies, are sparingly soluble in water. The following is a characteristic test for this acid:—When the acid, or any of its salts in solid state, are treated with a drop of strong nitric acid, the substance dissolves under a yellow colouration, to a yellow-reddish, or red solution; if to this be added excess of ammonia, it acquires a deep blood-red colour, which is permanent, at least for some hours. The 1-10,000th of a grain of the solid acid yields, with nitric acid, a well-marked yellow colouration, which assumes with ammonia distinctly a pale red hue. Gelseminine is, in pure state, a colourless, odourless solid, having an intensely bitter taste; it has strongly-basic properties, completely neutralising the most powerful acids; in free state, sparingly soluble in water, freely soluble in ether and chloroform. It is distinguished by the property of yielding, with concentrated sulphuric acid, a reddish brown colour, which, on being moderately heated, acquires a beautiful purple colour; this reaction is produced with even 1-100th of a grain of the alkaloid, or any of its colourless salts. Addition of bichromate of potassa to this acid solution produces no marked change. The alkaloid and the fluid extract are very poisonous substances. This paper contains a toxicological research, in consequence of a case of poisoning having accidentally taken place with the fluid extract of the *Gelsemium sempervirens*, which, we believe, is a native American plant.

Adirondack Mineral Springs.—Dr. Bell.—This spring exists near the Adirondack Mountains, in the State of New York. The water may be regarded as a saline chalybeate, with a considerable quantity of free carbonic acid; it is without smell and any very marked taste. One imperial gallon was found to contain the following substances, expressed in grains:—Sulphate of lime, 11·134; carbonate of lime, 18·543; carbonate of magnesia, 16·618; carbonate of iron, 5·040; carbonate of manganese, a trace; carbonate of potassa, 5·317; carbonate of soda, 5·135; carbonate of lithia, 0·023; chloride of sodium, 14·340; alumina, a trace; insoluble residue, 7·42; free carbonic acid, 67·3 cubic inches.

Naphthaline as a Protective against Moths and other Insects.—M. Markoe.—From the statements made by the author in this paper, it appears that the well and deservedly-known *savant*, Prof. Asa Gray, has thoroughly tested and obtained highly satisfactory results, conclusively proving that naphthaline may be advantageously used in museums, herbariums, &c., instead of camphor, as a very effective protection against moths and other insects.

The Journal of the Franklin Institute, November, 1869.

This number contains the following original papers relating to chemistry and allied sciences:—

Oxygen Manufactured on the Large Scale.—Prof. Morton.—The works for this purpose are at New York, and consist of retort-houses, engine-rooms, store-house, pumps for compressing gas in cylinders, and a gas-holder of 26,000 cubic feet capacity. The process is carried on as follows:—About 700 lbs. of manganate of soda are placed in the retort and heated to the requisite degree; superheated steam from a boiler is then admitted for about ten minutes. 2 equivalents of the manganate of soda, and 2 of water, react upon each other, as indicated by the following formula:—

$$2(MnO_3,NaO) + 2(HO) = 2(NaO,HO) + Mn_2O_3 + O_2$$

in other words, the water combines with the soda of the manganate to form a hydrate of soda, the manganic acid is converted into sesquioxide of manganese, containing only half the proportion of oxygen, and the other half of the latter passes off in free state. At the conclusion of this part of the process, the steam is shut off, and the super-

heated air is admitted for about fifteen minutes, whereupon the sesquioxide combines with more oxygen from the air, and is re-converted into manganic acid, which again combines with soda. The retorts in each furnace are charged with 700 lbs. of permanganate of soda, and by the consumption of two chaldrons of coke, and with the labour of three men, 25,000 cubic feet of oxygen are made per day. It is now sold at 5 cents (2½d.) per cubic foot, compressed in reservoirs up to a pressure of 250 lbs. to the square inch. The gas is of excellent quality and very pure.

Spectrum of the Aurora Borealis and Zodiacal Light.—M. Angström.

Analysis of Native Phosphate of Lead from Chester County, Pa., U. S.—Mr. Williams.—The author describes at great length his method of analysis, and quotes the following results:—(1) Mineral of dark olive-green colour contained, in 100 parts:—Phosphate of lead, 87·40; phosphate of lime ($3CaOPO_5$), 0·37; phosphate of protoxide of iron, 1·74; chloride of lead, 9·79; fluoride of calcium, 0·34; matter insoluble in acid, 0·42. (2) Of a yellowish green shade, in 100 parts:—Phosphate of lead, 85·89; phosphate of lime, 2·64; phosphate of protoxide of iron, 0·62; chloride of lead, 9·41; fluoride of calcium, 0·67; insoluble matter, a trace. (3) Mineral of a darker colour than No. 2, in 100 parts:—Phosphate of lead, 87 01; phosphate of lime, a trace; phosphate of iron, 1·39; chloride of lead, 9·13; fluoride of calcium, 0·91; insoluble, a trace. A separate assay for silver was made, giving 0·0037 per cent, or about 1·1 ozs. to the ton of 2000 lbs.

Native Gold from Venezuela.—Mr. Williams.—It contained, in 100 parts:—Gold, 93·583; silver, 3·687; iron, 1 60; copper, 0 650. No platinum, or metals associated with it, were detected.

Various Processes for Preserving Timber.—Mr. Beer.—This paper is written by the author with the view to contradict and correct several statements made by Dr. Ott, in a paper written by the latter on this subject, and published in this periodical.

New Chemical Nomenclature.—Dr. Ott.—This paper, a continuation of a former, contains much valuable information on the history of the nomenclature previous to Lavoisier's time.

The United States' Cabinet of Practical Geology and Mining.—Mr. Wilson.—From this paper we learn that a cabinet, or collection rather, has been organised at Washington for the collection and preservation of a complete system of geological and mineralogical memorials of the whole extent of the great Republic. M. Roessler, educated at Vienna, and formerly in the Austrian geological service, has charge of this institution.

Electricity Applied to Registering Vibrations.—Mr. Cooley.

Easy Rules for Astronomical Refraction.—Mr. Lyman.

Processes for Preserving Timber.—Dr. Ott.—A continuation of a former paper. This part chiefly treats on what is called Heinemann's process of preservation, by means of forcing molten resin into timber the sap from which has been previously exhausted.

December, 1869.

Separation of Animal from Vegetable Fibre.—Mr. Stuart.—The author subjects rags, carpet cuttings, old carpets and other waste material consisting of mixed fibres, to a solution consisting of 100 gallons of hot water, 100 lbs. of commercial sulphate of alumina, and 50 lbs. of common salt. In this solution the material is kept boiling until the vegetable fibre is decomposed; the material is then well washed and dried, and scribbled, or carded.

Electro-Plating with Iron.—Mr. Clay uses a bath composed of ferrous sulphate combined with sulphate of ammonia, potassa, or soda.

Tellurium Ores in the United States.—M. Roessler.—The author states that a mineral named montanite, from the locality where it was found, is a tellurate of bismuth associated with pure telluride of bismuth; another variety contains sulphur in addition (5 per cent), and its formula is $BiS_3+2BiTe_3$. The montanite is a yellowish mineral, with waxy lustre, and contains, according to assay, £20,000 worth of gold to the ton of 2000 lbs. Tellurium minerals are (the author observes) very rarely met with, but when found contain generally much gold and silver, which are, however, excluded from native tellurium.

NOTES AND QUERIES.

Egg and Blood Albumen.—Can any of your readers inform me of a good method of testing the value of egg and blood albumen.—W. B.

Production of Ozone.—Would you kindly inform me, through the medium of your valuable journal, the cheapest and best mode of producing ozone in quantity, and if a process described in the *Daily Telegraph* some months since is practicable, and if protected by a patent?—X. Y. Z.

Colours and Pigments.—Can any of your readers inform me of any, or the best, works treating on the manufacture of pigment colours, painters' colours, and paper printers' colours; also, what work is the best on the manufacture of blood and egg albumen.—A Reader, Church, near Accrington.

Distilling Tar.—Can you refer me to any work that treats upon the process of distilling tar? I am in a place where I can procure 6 or 7 tons of tar from the gas works every week. There is a tar distiller not far from the town, but he will tell me nothing, even for money. I should like to know the process—how long it is boiled, what vitriol to put in, and how to separate the contents when the pitch is run off. I know that colours are made from it, as well as oil, ammonia, carbolic acid, &c.—A Chemist.

Gutta-Percha Vessels for Chemical Uses.—Erroneous views have been held and circulated concerning the durability of gutta-percha under the action of various reagents. We are ordinarily told that it is absolutely unacted upon by cold mineral acids, with the single exception of the sulphuric at 1·6 sp. gr. and upwards. This is far from being the case. There is, indeed, no immediate corrosion, or other rapid and striking change; but, in course of time, the surface becomes overspread with a thin buff-coloured layer, which may be easily rubbed off. This change extends gradually deeper and deeper, till the whole mass loses its coherence and splits in various directions. I have before me a number of jugs which have been used for nitric, chlorhydric, and dilute sulphuric acids, as, also, for solutions of stannous, stannic, and ferric salts, and which, in less than three years' service, have become quite worthless; on being sent for repairs to a dealer in such articles, they were returned with the remark that they "could not be mended, as they had been used for acids." I find that the disintegration in question can be very much retarded if the vessels are always rinsed in cold water immediately after being used.—J. W. Slater.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Joseph Welch.—A work, by the Editor of this journal, treating on the madder extracts and pigment colours is in the press.

March.—It cannot be made. (2) The various processes for the manufacture of artificial alizarine are all patented. (3) Messrs. Walker's address is 43, Mansell Street, Aldgate, E.

George E. Davis, Rev. E. Smith, Professor Smith (Sydney), Professor A. M. Thomson (Sydney), J. Gulson Burgess, and J. W. Slater. These correspondents are thanked for their communications, which shall receive due attention.

An Old Subscriber (Maryland, U. S.).—The address of Mr. Siebe, the maker of the refrigerating machine, is Mason Street, Lambeth, London. *Engineering* of Nov. 27th, 1868, gives a description of the apparatus in use at Truman, Hanbury, and Co.'s Brewery.

George Gore, F.R.S., Professor Heaton, Professor Cameron, and H. N. Draper.—Received with thanks.

Books Received.—"The Manchester Examiner and Times," Jan. 29, 1870, containing a letter by Dr. Bedford on "The Flames upon the Sun." "On the Combining Power of Chemical Elements," by Prof. S. D. Tillman, New York. "The Medical and Surgical Reporter."

AMERICAN SUPPLEMENT.

New York, April, 1870.

Chittenango Springs, Madison Co., N. Y.

The sulphuretted springs of Chittenango are situated in the town of the same name in Central New York, a few miles southerly from the Chittenango station of the New York Central Railroad. The three springs of the greatest importance—called the "White Sulphur," the "Cave," and the "Magnesia" springs—flow within two hundred yards of each other, near the base of a hill two hundred feet or so in height, beneath the shadow of which a hotel has been built, capable of accommodating five hundred guests.

The "White Sulphur" spring flows from the hillside, near the hotel, in an abundant stream, exhaling sulphuretted hydrogen, which can be perceived at some distance. The water has an opalescent appearance from precipitated sulphur, is cool, and has a strong sulphuretted taste.

In a cave in the same hill, but about two hundred yards to the south of the first-named spring, is found the "Cave" spring, similar in its character to the last, but less abundant; and below this, in the field, is the "Magnesia" spring—the strongest water, but the least abundant.

The following analyses were recently made in the Editor's laboratory, with the assistance of W. H. Chandler and F. A. Cairns.

The method employed for determining the sulphur compounds was a modification of the one employed by Simmler in the analysis of the Stachelberg water, the account of which was published in Erdmann's Journal, vol. 70. The alterations introduced lessen to a great extent the amount of analytical work to be done at the spring. The following brief statement may prove of interest:

1. In a glass-stoppered bottle, to one litre of water was added an excess of a neutral solution of nitrate of silver.

2. To another litre was added an excess of a solution of chloride of cadmium.

3. Through a third litre pure hydrogen was transmitted until the gas, after passing through the water, no longer decolorized a dilute solution of iodide of starch. An excess of a solution of chloride of cadmium was then added.

These three bottles were well agitated, securely sealed, and transported to the laboratory. From each the precipitate was filtered, washed, dissolved, and oxidized by fuming nitric acid and chlorate of potassa, filtered, and the sulphuric acid determined in the filtrate with chloride of barium.

No. 1. This precipitate contained the sulphur, existing in the form of sulphides and hyposulphites.

No. 2. Contained the sulphur existing in the form of sulphides, including the free sulphuretted hydrogen.

No. 3. Contained the sulphur present in the form of sulphuretted sulphides. The difference between No. 3 and No. 2 indicated the amount of sulphur as free sulphuretted hydrogen; and by deducting No. 2 from No. 1, the amount of hyposulphites was ascertained.

In the original filtrate from No. 1, the sulphuric acid was determined, after removing the excess of silver by hydrochloric acid.

The following results were obtained:

	"White Sulphur Spring." grains.	"Cave Spring." grains.	"Magnesia Spring." grains
Hydrosulphate of sodium..	0·117	0·386	0·757
Hydrosulphate of calcium .		1·123	0·929
Sulphate of soda.....	0·213		
Sulphate of lime.....	81·420	106·126	115·085
Sulphate of strontia.....	trace	trace	trace
Sulphate of magnesia.....	1·953	7·589	12·718
Hyposulphite of soda.....		0·257	0·020
Bicarbonate of magnesia...	22·017	23·973	20·779
Bicarbonate of iron	0·078	0·156	0·325
Chloride of potassium.....	0·156	0·233	0·333
Chloride of sodium.....	1·037	1·569	1·833
Chloride of lithium	trace	trace	trace
Alumina.....	0·082	0·222	trace
Silica.....	0·286	0·519	0·577
Total solid contents per gal. (231 cub. in.).....	107·359	142·113	153·356
Total sulphur in the metallic sulphides and sulphuretted hydrogen.....	0·339	1·397	2·454

CUBIC INCHES OF GAS PER GALLON.

Sulphuretted hydrogen gas	0·884	2·754	5·623
Carbonic acid gas	20·480	15·934	19·436

Sprinkling the Streets with Chemicals.

REPORT OF PROF. C. F. CHANDLER,

CHEMIST TO THE METROPOLITAN BOARD OF HEALTH.

Mr. Moritz Marcus, in a communication to the Board of Health, states that he has invented and patented a chemical compound for sprinkling the streets, which consists of chloride of calcium and common salt dissolved in water.

Mr. Marcus claims—

1. That his compound holds moisture, and in so doing solidifies the dust; and that it need not be applied to the streets oftener than once or twice a day.

2. That it renders pavements more durable, and that it will prevent the decay of the wooden pavements.

3. That it purifies the air and removes contagion, while pure water is often injurious to health.

4. That its use will diminish the labor of watering the streets, as one sprinkling with the compound is equivalent to four or five sprinklings with pure water.

5. It costs six cents per pound, and fifty pounds are sufficient for 500 gallons of water. The labor saved by the less frequent sprinkling required when this compound is used will compensate for the cost of the material.

These are the claims which the inventor makes for his material.

The proposition is simply to use a deliquescent substance to retain moisture in street dust. Chloride of calcium and many other salts have the property of absorbing moisture from the air, which they retain at ordinary temperatures, becoming wet or even dissolving in the water absorbed to a permanent solution; the term deliquescent describes this property.

The idea of Mr. Marcus is by no means new; it has come up from time to time, and has been repeatedly shown to be impracticable. The use of chloride of cal-

cium for street sprinkling was suggested more than forty years ago.

In 1859 experiments were made in Paris, on the walks and roads of the Bois de Boulogne. It was then found that the effect lasted, in dry weather, five or six days; but that, as the chloride of calcium cost two cents per pound, and as one-half pound was required for every square yard of surface, the process was too expensive.

In 1862 experiments were again made in Paris, a cheaper impure variety of chloride of calcium being employed, upon which a Government report was published. The material cost one cent per pound, and one pound was required for every square yard of surface at each application.

The effect of an application of the material lasted about three days. In dry weather occasional sprinkling with water was necessary. Rain washed the chloride of calcium into the sewers at once. It was found that the use of this substance gave rise to the formation of a black, sticky, bad-smelling mud, very offensive to the public.

In 1864 experiments were again made at Paris, the chloride of magnesium being employed on account of its cheapness.

One pound of the material was required for every square yard of surface. It was put on at night, the effect lasting twenty-four hours; the second day a little water was required, on the third day considerable water was required. On the fourth day it was necessary to make a fresh application. The chloride of magnesium cost one-half cent per pound. The expense of sprinkling ten thousand square metres, a little more than as many square yards, for three days, including labor, material, &c., was, with chloride of magnesium, 111.90 francs, or $30.21; with pure water, 35.50 francs, or $9.58. Showing that sprinkling with a deliquescent salt, costing only half a cent per pound, costs three times as much as sprinkling with water.

In July, 1865, the engineer-in-chief of roads and bridges reported—

1. That the use of deliquescent salts is considerably more expensive than pure water for sprinkling the streets.

2. That pure water has the advantage, that, while it lays the dust, it cools and moistens the dry air of summer; while the deliquescent salts absorb the little moisture present in the air, making it dry and disagreeable, without in any way cooling it, and therefore exerting an influence prejudicial to health.

3. They form with the street dust a disagreeable, sticky, and offensive mud.

4. They can be used in those places only where they are much cheaper than in Paris, or where the necessary supply of water cannot be obtained.

From these statements it is apparent that the mixture of Mr. Marcus, costing six cents per pound, cannot be used economically, as the chloride of calcium at one cent was too expensive in Paris, and the chloride of magnesium at one-half cent per pound cost three times as much as pure water.

Mr. Marcus' other claim, that the mixture of chloride of calcium and common salt will remove contagion from the air, is probably founded upon the supposition that chloride of calcium is identical with bleaching powder, commonly called chloride of lime, which is not the case. They are entirely different substances. Chloride of calcium is not a disinfectant, and does not possess any properties which would warrant its use for sanitary purposes.

The Various Methods for the Determination and Separation of Baryta, Strontia, and Lime.

BY PAUL SCHWEITZER, PH.D.

(Continued from the February Number.)

II. *Determination of Strontia.*

Strontia is generally precipitated from its solutions as sulphate or carbonate of strontia, and weighed as such; the determination as nitrate of strontia being preferred only in special cases. The general characteristics of the salts of strontia are very much the same as those of baryta. The same precautions have to be observed in their precipitation; and the same affinity, though not quite as strongly marked, exists between them and the salts of the alkalies. In incinerating the paper on which precipitates of strontia have been filtered, special care has to be taken to remove the precipitate as much as possible from the filter, and to burn the latter at a comparatively low temperature, on account of the volatility of the strontia salts. This volatility is especially noticeable in the hydrous salts, as we get them by precipitation and subsequent drying. In fact, the precipitated and dried salts of the alkaline earths differ in a marked degree from the ignited precipitates, whether artificial or as found in nature, and a deeper study of them in the various minerals would be not only interesting to the chemist, but also afford valuable aid to the geologist.

Sulphate of Strontia.

For all the determinations of strontia, pure crystals of nitrate of strontia were pulverized and dried in a platinum dish until the weight became constant. The dried powder dissolved to a clear solution in water, and represented SrO,NO_5. In determining the strontia in the form of sulphate, we must be more careful than with the corresponding baryta salt, in order to arrive at accurate results. Sulphate of strontia is more readily soluble in water and acids than sulphate of baryta, and an excess of hydrochloric as well as of sulphuric acid has therefore to be avoided. We must further add about the same volume of alcohol, and wash the precipitate with a mixture of equal parts of alcohol and water. This precipitate has to be well washed, as in the case of the baryta precipitate, to prevent the filter paper from becoming charred by retained sulphuric acid. This acid, however, can be removed easier than in the case of sulphate of baryta, probably, as said before, on account of the very voluminous character of the freshly precipitated sulphate of strontia, which is a mere hydrate, and not a bisulphate, as stated in some books; for whether precipitated by free sulphuric acid or an alkaline sulphate, no difference exists in appearance or behavior. The precipitate of sulphate of strontia will be very voluminous at first, so that it is better to let it stand for at least twenty-four hours in the cold before filtering, when it will have lost most of its water of crystallization and have become greatly reduced in volume.

For the following three determinations nitrate of strontia was precipitated with an excess of dilute sulphuric acid; B with more acid than A, and C with more than B, and afterwards an equal volume of alcohol added. After standing twenty-four hours the precipitates had changed totally in appearance, and appeared like sulphate of baryta; they were filtered, washed with the proper precautions, dried, ignited, and weighed.

	A.	B.	C.
SrO,NO_5, used	2·1924	2·5422	2·4353
SrO,SO_3, found	1·8990	2·2000	2·1000
SrO,NO_5, calc.	2·1888	2·5357	2·4204
"	99·84 p. c.	99·75 p. c.	99·39 p. c.
	—0·16 p. c.	—0·25 p. c.	—0·61 p. c.

We learn from these analyses that too large an excess of sulphuric acid will readily dissolve some of the precipitated sulphate of strontia. The same will be the case with hydrochloric acid, but in a more marked degree; for in precipitating a neutral solution of nitrate of strontia by dilute sulphuric acid, and comparing the result with a precipitate obtained by dilute sulphuric acid in a solution acidulated by hydrochloric acid, and treating the precipitate twice with the same acid, as described under baryta, we find more than 4 per cent. of the sulphate dissolved. In these two, and also the third analysis, where neutral nitrate of strontia, after being mixed with 3 grammes chloride of sodium and 3 grammes chloride of potassium, was precipitated by dilute sulphuric acid, the bulky, voluminous precipitates were reduced to a granular condition by boiling, and after decanting the clear supernatant liquid, washed with hot water. In washing these precipitates it depended, of course, on personal experience to tell exactly the time when the precipitates were washed enough, which will be generally the case when the wash-water will give a cloudiness with a baryta salt only after some time.

	A.	B.	C.
SrO,NO_5, used	2·1860	2·4942	1·9090
SrO,SO_3, found	1·8667	2·0483	1·6370
SrO,NO_5, calc.	2·1515	2·3608	1·8868
	98·42 p. c.	94·65 p. c.	98·83 p. c.
	−1·58 p. c.	−5·35 p. c.	−1·17 p. c.

Hydrochloric acid will also dissolve about 4 p. c., and water about 1·5 p. c. of the precipitated sulphate of strontia, while the latter will retain about 0·5 p. c. of alkaline salts.

In the determination of sulphuric acid by means of a salt of baryta good results were obtained; but we found that, besides the affinity of the sulphate of baryta for alkaline salts, an affinity also existed for the baryta salt in solution. Those two affinities are reversedly strong in the sulphate of strontia; for while of the alkaline salt only about 0·5 p. e. is retained, of the alkaline earth a great deal more is held by the precipitate, which by long washing may be reduced somewhat in quantity; this, however, is attended again with losses, owing to the solubility of the sulphate of strontia. For the following experiments pure sulphate of potassa was precipitated by a solution of nitrate of strontia, and after boiling to reduce to the proper volume, that is, to about one-tenth of the volume of the freshly precipitated sulphate, filtered, washed, and weighed:

	A.	B.	C.
$KO.SO^3$, used	3·1915	3·8385	5·9200
$SrO.SO^3$, found	3·4270	4·1520	6·4380
$KO.SO^3$, calc.	3·2537	3·9420	6·1124
	101·95 p. c.	102·69 p. c.	103·25 p. c.
	+3·53 p. c.	+4·27 p. c.	+4·83 p. c.

A was here washed longer than B, and B longer than C. The difference is calculated from the amount obtained by sulphate of strontia without the addition of alcohol, viz.: 98·42 p. c.; the equivalent of sulphate of strontia and sulphate of potassa giving only an actual difference of 0·05 p. c. in A. For 1·58 p. c. of sulphate of strontia lost, will amount to 0·0550 grammes for 3·4270, corresponding to 0·0522 grammes of sulphate of potassa, making in all 3·3059 gr. or 103·58 p. c.

Carbonate of Strontia.

The carbonate of strontia was precipitated in the same manner as described under carbonate of baryta. It is not so voluminous as the sulphate, chromate, or oxalate of strontia, and changes quicker than any of the others into the heavy granular form, in which it may be freed most conveniently from other salts by washing. In a number of determinations of baryta and strontia as carbonates I found it most convenient and at the same time most accurate to remove the well-dried precipitates as completely as possible from the filter, burn the latter in a platinum spiral, and bring the ashes in a platinum crucible together with the rest of the precipitate. The crucible was then heated over a Bunsen burner, so that the flame was about ½ inch distant from the bottom, and after ten or fifteen minutes the heat was raised, allowing the crucible to become at the lower half, of a dull red color for a minute or so. The results will be the same as those obtained by the troublesome treatment with carbonate of ammonia. A was precipitated without, B with the addition of alkaline salts, a very small amount of which was retained by the carbonate of strontia.

	A.	B.	
SrO,NO^5, used	2·7850	2·5300	
SrO,CO^2, found	1·9450	2·2011	as $SrO.SO^3$
SrO,NO^5, calc.	2·7889	2·5370	
	100·11 p. c.	100·28 p. c.	
	+ 0·11 p. c.	+ 0·28 p. c.	

Chromate of Strontia.

The following experiments with chromate of strontia were undertaken to determine the possibility of a separation of strontia from baryta by means of a chromate. We know that it is comparatively easy to precipitate chromate of strontia from a concentrated solution of a strontia salt. But the precipitated chromate of strontia is not so easily soluble as we are generally disposed to believe, for from a solution which does not contain more than $\frac{1}{40}$ of a per cent (in 100 cubic centim. 0·025 grammes SrO), we are able to precipitate, by heating, a certain amount of strontia as chromate. In fact, let me state here that the solubility of a substance, as determined by treatment with solvents, differs from the solubility of the same determined by the amount remaining in solution in the filtrate from a precipitation, notwithstanding the presence of the same salts and the similarity of the treatment; therefore all corrections in analytical chemistry must be regarded with suspicion and used with caution.

It appears that we are able within certain limits, which must be allowed in analytical chemistry (that is to say, from a fluid, which contains more than a mere trace), to precipitate more than 40 per cent of a dissolved salt of strontia as chromate. As this, however, is soluble in water, we may be able to remove it from any other precipitate by washing, yet have to wash then for a longer time, and employ a larger volume of water, than we generally would like in quantitative analysis. In appearance the chromate of strontia differs from the chromate of baryta by its bulkiness, which it retains in cold and hot solutions; while from a fluid containing very little strontia it is precipitated crystalline, and differing then still more from the chromate of baryta.

Three determinations were made, A being precipitated from a solution of 250 cb. cm. B and C from a solution of 500 cb. cm. The precipitate in A appeared

immediately, while in B and C it appeared after some time upon boiling.

	A.	B.	C.
SrO,NO_5, used	2·6040	0·7405	0·2660
SrO,CrO_3, found	1·8865	0·3080	0·1080
SrO,NO_5, calc.	1·9558	0·3193	0·1124
	75·10 p. c.	43·12 p. c.	42·25 p. c.
	−24·90 p. c.	−56·88 p. c.	−57·75 p. c.

The precipitates were filtered after 24 hours standing, and after sufficient washing weighed on a dried filter. They contained mere traces of alkalies before the spectroscope, and seem to indicate that about 40 per cent is the limit to which strontia can be thus precipitated.

Oxalate of Strontia.

The same may be said with regard to oxalate of strontia as has been said about oxalate of baryta. It is more soluble than the lime salt, not quite as voluminous as the baryta salt, and differs more from the carbonate of strontia in appearance and behavior than the oxalates of baryta and lime differ from their carbonates. It will retain only traces of alkaline salts, and even those may be removed by long washing. A and B were precipitated from a solution of 500 cb. cm., B after the addition of 3 grammes of KCl and 3 grammes of NaCl, and the precipitates washed with hot water.

	A.	B.
SrO,NO^5, used	2·7150	2·8230
SrO,SO^3, found	2·2910	2·3842
SrO,NO^5, calc.	2·6406	2·7480
	97·26 p. c.	97·36 p. c.
	−2·74 p. c.	−2·64 p. c.

The Spectrum of Artificial Alizarine.

COMMUNICATED BY PROFESSOR JOHN H. APPLETON, OF BROWN UNIVERSITY, R. I.

My assistant, Mr. H. W. Vaughan, has been making a series of observations on the spectra of various colored solutions. In the course of the experiments we have observed the interesting fact, that *the spectrum of artificial alizarine is identical with that of alizarine extracted from madder.*

In making these experiments the inverted microscope of J. & W. Grunow, of New York, was used, but attached as an eyepiece was a micro-spectroscope of the Sorby-Browning pattern, for the comparison of two spectra at once. The micro-spectroscope was also made by Grunow.

The *alizarine of madder* employed was the commercial article produced by Messrs. Schaff & Lauth, of Strasbourg; the *artificial alizarine* was that furnished by Messrs. Perkin & Son, of London.

Considerable difficulty was at first experienced in obtaining a solution which would give a satisfactory spectrum, but this difficulty was at length overcome as follows: First the alizarine was in each case purified by placing it in a platinum capsule and covering with a glass funnel, into which the alizarine was sublimed at a gentle heat. The yellow crystals thus produced were then dissolved in *caustic soda*, that reagent being found to afford a solution which furnished far the most characteristic spectrum. This alkaline solution was gradually diluted until of such strength as to give a good spectrum; or the solution was placed in a wedge-shaped glass cell, such that, by moving the cell, solutions of different thicknesses were obtained with very little trouble.

Italian Petroleum.

Not long since a grant was obtained from the Italian Government of the exclusive right to sink wells for petroleum in an extensive tract of country on both sides of the Taro river, in the province of Parma, a few miles south-east of the city of Parma. Samples of the petroleum found in the district were brought to New York, with a view of interesting capitalists here in the enterprise. These samples were examined in the editor's laboratory, and as they present some remarkable contrasts in composition, although they were all collected upon a tract of thirty square miles, we think the results should be placed on record. The tract of land forms a basin between spurs of the Apennines, around and between the villages of Fornovo, fourteen miles from Parma and Medesano, ten miles from the same city. According to Prof. Stoppani, of Milan, the valley, in its geological formation, partakes of the character of the Apennines, consisting of three great deposits or layers, belonging to an epoch anterior to the Tertiary, of which the following is a section:—

5. Soil abounding in marl, covered with an ash-colored sand containing Tertiary fossils.
4. Tertiary deposits, generally horizontal.
3. A series of strata of marl and calcareous conglomerate, containing remains of marine plants, and more or less inclined.
2. Argillaceous schist, marlite, and calcareous rocks.
1. Mixture of gneiss, mica schist, and calcareous rock.

The entire territory bears evident marks of volcanic action, such as the appearance of huge blocks of serpentine abruptly emerging from the ground; the extensive oozing out of gaseous mud and gases; springs of brine, mineral waters, and petroleum. Oil-wells have long existed in this region. Volta mentions them; and Amoretti, a writer of the last century, says he saw, near Miano, a well 125 feet deep, full of petroleum. In 1802 there was a flowing well at Miano, which yielded an abundant supply of oil. Parma and the town of San Domingo were lighted with it for several months. Its use was discontinued chiefly for want of suitable lamps.

A merchant in Parma has of late monopolized the trade; before the introduction of American petroleum he sold about 24,000 kilogrammes per annum.

There is a very marked difference in the appearance of the oil from different points on the tract. The oil from the neighborhood of the Church of St. Andrea has a reddish color, like burnt sugar, while the oil from Miano is of a pale yellow color.

At St. Andrea there are about 100 wells, mostly abandoned, having an average depth of 180 feet. At a little depth, salt water is generally found; as the well is driven deeper, petroleum generally appears. One well yielded 800 kilogrammes of oil per day for some time, but was finally abandoned for want of the proper masonry to support the sides. The oil sold for from $2.50 to $3.00 per gallon. The wells are generally 4 or 5 feet in diameter, are cylindrical, and are walled from mouth to bottom. The oil is never pumped, but is skimmed, every week or fortnight, from the surface of the water on which it floats, by means of a copper or iron pail attached to a cord.

In digging wells gases are evolved in large quantities. Within the recollection of persons now living seven men have been killed in wells by the gases. The following are the results of the chemical examination made by C. F. Chandler and M. Alsberg. The sample

were examined by fractional distillation, and the results were arranged according to the usual American standard, which recognizes as—

1. Gasolene.....all above 65° Baumé.
2. Naphtha..... " between 65° and 60° B.
3. Burning oil... " " 60° and 36° B.
4. Lubricating oil " below 36° B.

The percentages represent volumes, not weights.

No.	Locality.	Density.		Gasolene, above 65° B.	Naphtha, 65° to 60° B.	Burning Oil, 60° to 36° B.	Lubricating Oil, Below 36° B.	Coke and Loss.
1	Fornovo District.....	0·9065	25° B.	..	..	..	94·50	5·50
2	" "	0·9060	25° B.	..	..	..	96·60	3·40
3	Fornovo District, Ozzano	0·9065	25° B.	..	..	..	97·03	2·97
4	" " "	0·9081	25° B.	..	..	..	96·61	3·39
5	Medesano District, Miano	0·9125	24° B.	..	..	..	97·27	2·73
6	Fornovo Dist., Neviano del Rossi..... ..	0·8922	28° B.	..	..	39·81	56·76	3·43
7	Medesano District, Miano	0·8572	34° B.	..	..	58·93	38·21	2·86
8	Fornovo District, Ozzano	0·9021	26° B.	..	..	28·33	77·93	3·74
9	Fornovo Dist., Neviano del Rossi.....	0·7960	47° B.	..	10·00	78·21	9·64	2·15
10	Fornovo Dist., Neviano del Rossi.....	0·7826	50° B.	..	9·20	89·65	..	1·15
11	Pennsylvania average...	0·8110	44° B.	10·00	10·00	76·00		4·00

The first five samples are heavy lubricating oils; 1 to 4 exhibit a clear red color; while No. 5 has a dark yellowish brown color. They are almost free from odor, and none of them yield any "burning oil." Nos. 6, 7, and 8 are lighter oils, containing burning and lubricating oil, but no gasolene and no naphtha. No. 6 has a greenish yellow color; No. 7, a clear yellow; No. 8, a clear red color. They all possess an agreeable odor. No. 9 has a deep yellow color, faint odor, and contains naphtha. No. 10 is the most remarkable of the entire series. It has a pale straw color, an agreeable odor; contains naphtha, but no lubricating oil; it consists almost entirely of burning oil. No. 11 is an average sample of Pennsylvania petroleum fresh from the wells.

These Italian oils are very remarkable in differing from each other to such a degree, when they come from wells so near each other. They are also characterized by their freedom from the disagreeable odor so characteristic of much of the American petroleum.

Saltness of the Waters Around the Island of New York.

With a view to determining whether the waters around New York island were sufficiently salt to warrant the erection, at the middle and upper portions of the city, of fish markets, where the fish should be kept alive in basins or cribs, the following analyses were made in the editor's laboratory:—

I.—North River, on the South and West Sides of the Island.

Locality.	Depth.	Salt contained in one U. S. Gallon.
Between Castle Garden and Governor's Island, below the City.....	Surface.....	807 grains.
Off 25th street, 300 ft. from pier head.....	Bottom, depth, 26 feet.....	1,037 "
Off 25th street, 300 ft. from pier head.....	Surface.....	328 "
Off 25th street, mid-channel.....	Bottom, depth, 36 feet.....	1,140 "
Off 51st street, 400 ft. from pier head.....	Bottom, depth, 36 feet.....	812 "
Off 51st street, 400 ft. from pier head.....	Surface.....	266 "

II.—East River.

Off 35th street.....	Surface.....	1,088 "

These results show that the water of the Hudson river flows over the heavier water of the bay; and notwithstanding the ebb and flow of the tides, admixture of the fresh and salt water takes place imperfectly. There is some difference in the specific gravity of the waters; but one would not suppose the difference sufficient to prevent mixture when the entire depth of water is but from 26 to 36 feet. The lightest water from the surface off Fifty-first street, in the North river, had a density of 1·0055, while the water from the bottom at the same spot had a density of 1·0135. The heaviest water, from the bottom, in mid-channel, off Twenty-fifth street, had a density of 1·018.

These samples were not all taken at exactly the same moment; two or three hours were spent in sailing round the island to collect them, consequently they do not all represent the same condition of the tide. They show, however, that fish markets can be erected as high as Fifty-first street, and that a supply of salt water can always be obtained by drawing from the bottom, or by making an inclosure which should be provided with openings for the supply of water, near the bottom only.

Recent examinations by Dr. H. Endemann, at the laboratory of the Board of Health, have shown that these waters are not rendered specially impure by the sewage poured into them all along the margin of the island.

The Purity of Croton Water.

The water supplied to the citizens of New York, at the liberal rate of 65 gallons to each person daily, is collected by the various branches of the Croton river from an area of 338 square miles in Westchester, Putnam, and Dutchess counties. The character of this water-shed is a sufficient guarantee of the purity of the water. The surface of silicious gravel rests on hard Laurentian gneiss, and is open pasture or woodland, with few swamps. No factories line the streams, which are liable to contaminate the waters with refuse chemicals, and no towns or large villages exist anywhere in the district to pollute the waters with sewage. A recent survey of the water-shed has indicated fifteen points at which dams can be erected for the creation of large storage reservoirs, whose joint capacity would be 67,000,000,000 gallons, or a supply, at the present rate of consumption, for 1000 days. One of these dams, 650 feet long, is now in process of construction at Boyd's Corner, in Putnam county, 23 miles from the mouth of the aqueduct. When this dam is completed, it will flood an area of 303 acres, and the reservoir thus produced will contain 3,369,206,857 gallons, or a supply for 50 to 55 days of drouth.

An analysis of the Croton water recently made in the editor's laboratory gave the following results for one U. S. gallon of 231 cubic inches:

	Grains.
Soda	0.326
Potassa	0.097
Lime	0.988
Magnesia	0.524
Chlorine	0.243
Sulphuric acid	0.322
Silicia	0.621
Alumina and oxide of iron	a trace
Carbonic acid (calculated)	2.604
Water in bicarbonates (calculated)	0.532
Organic and volatile matter	0.670
Total	6.927
Less oxygen, equivalent to the chlorine	0.054
	6.873 grs.

These acids and bases are probably combined in the water as follows:

	Grains.
Chloride of sodium	0.402
Sulphate of potassa	0.179
Sulphate of soda	0.260
Sulphate of lime	0.158
Bicarbonate of lime ($CaO,HO,2CO_2$)	2.670
Bicarbonate of magnesia ($MgO,HO,2CO_2$)	1.913
Silicia	0.621
Alumina and oxide of iron	a trace
Organic matter	0.670
Total	6.873

On evaporating a gallon of this water a residue of only 4.78 grains is obtained, the bicarbonates of lime and magnesia being left as simple carbonates.

The following tabular statement shows how favorably the Croton compares with the waters supplied to other cities:

PURITY OF CITY WATERS.

Impurities contained in one wine gallon of 231 cubic inches expressed in grains.

City.	Source.	Inorganic Matter.	Organic and Volatile Matter.	Total Solids.
New York.	Croton, 1869	4.11	0.67	4.78
" " .	Well, 8th Av	38.95	4.59	43.54
Brooklyn	Ridgewood, 1869	3.37	0.59	3.92
Jersey City.	Passaic River	4.58	2.86	7.44
Trenton	Delaware River	2.93	0.55	3.48
Philadelphia	Schuylkill River	2.30	1.20	3.50
Boston	Cochituate Lake	2.40	0.71	3.11
Albany	Hydrant	8.47	2.31	10.78
Troy	Hydrant	6.09	1.34	7.43
Schenectady	Well, State St	46.88	2.33	49.21
Utica	Hydrant	5.50	0.96	6.46
Syracuse	New Reservoir	12.13	1.80	13.93
Rochester	Genesee River	12.02	1.23	13.25
Cleveland	Lake Erie	4.74	1.53	6.27
Chicago	Lake Michigan	5.62	1.06	6.68
Dublin	Lough Vartry	1.77	1.34	3.11
London	Thames River	15.55	0.83	16.38
"	Well, Leadenhall St.	90.38	9.59	99.97
Paris	River Seine	7.83	1.00	8.83
Amsterdam.	River Vecht	14.45	2.13	16.58
" .	Well	64.55	4.38	68.93

Lead in the Croton Water.

The attention of the Metropolitan Board of Health having been called to the frequent cases of chronic lead poisoning which occur in the city, the chemist to the Board, C. F. Chandler, was directed to investigate both the Croton water and the various hair tonics, washes, etc., with a view to discovering the probable cause.

Accordingly examinations were made of Croton water which had been in contact with lead for different lengths of time, under usually occurring circumstances, of which the following are the results.

1. A gallon of Croton water from a lead-lined cistern, in which it had stood several weeks, was found to contain 0·06 grain of metallic lead.

2. A gallon of water which had remained six hours in the lead pipes of the chemist's residence yielded 0.11 grain metallic lead, a considerable portion of which was visible to the eye, in the form of minute white spangles of the hydrated oxycarbonate ($PbO,HO + PbO,CO_2$).

3. Water drawn from one of the hydrants of the School of Mines laboratory, in the middle of the day, when the water was in constant motion, yielded traces of lead. This water reaches the school through about 100 to 150 feet of lead pipe.

These results indicate the source of many hitherto unaccountable cases of lead poisoning, and are of a character to alarm the residents of New York, and to lead them to adopt precautionary measures, for protection against this insidious cause of disease. Many have already introduced, as a substitute for lead pipe, the "tin-lined" or "lead-encased block tin" pipe.

Certainly no pains should be spared to impress upon servants the importance of allowing the water to run for a few minutes before taking it for drinking or cooking purposes, specially early in the morning, after the water has stood all night in the pipes. The habit of filling the tea kettle from the boiler, or of using water from the boiler for any purpose except washing, is very dangerous.

Experiment No. 2 explains a case which recently occurred in New York. An elderly gentleman was completely prostrated with paralysis or palsy. His physician at once suspected lead poisoning from his symptoms, and instituted inquiries which developed the fact that the patient had been using wheaten grits for dyspepsia, and that the first duty of the cook in the morning had been to soak them, preparatory to boiling them. She had therefore used daily the water which had stood all night in the pipes. The occurrence of a considerable portion of the lead in experiment No. 2, in suspension, instead of solution, is an additional argument for the use of filters, though it will of course be useless to employ them unless they are frequently reversed, that they may be cleansed.

Provisions against Kerosene Accidents—A New Bill before the Legislature.

The following is a literal copy of the bill introduced in the State Senate, on the 11th inst., by Senator Norton, relating to the better protection of the public against accidents from the use of kerosene oil:

AN ACT TO PROVIDE AGAINST KEROSENE ACCIDENTS IN THE CITIES OF NEW YORK AND BROOKLYN.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. It shall not be lawful for any person, firm, or company, in the cities of New York and Brooklyn, to

deal in, sell, or give away any refined petroleum, kerosene, or other burning fluid, at retail, or in less quantities than five barrels, for illuminating purposes in any dwelling-house, store, shop, restaurant, car, coach, or other vehicle, unless such article shall stand a fire-test of not less than one hundred and ten degrees (110°) Fahrenheit, as indicated by the most improved pyrometer. No person, firm, or company shall deal in, sell, or give away any refined petroleum, kerosene, or other burning fluid, without taking out a license therefor, which license shall be granted for one year by the Mayor of the respective city, upon payment of the sum of ten dollars for each license, a certificate of which shall contain the name of the person, firm, or company, and the precise place at which the business is to be carried on; the certificate shall be posted in some conspicuous place upon said premises. The funds so collected shall be deposited in the City Treasury.

Sec. 2. The Mayor of the city of New York shall, within ten days after the passage of this act, appoint three inspectors, and the Mayor of the city of Brooklyn shall, within the same time, appoint two inspectors. The inspector shall hold office at the will of the Mayor, and shall receive an annual salary of not more than three thousand dollars, payable from the funds derived from the issue of licenses, in monthly payments, by order of the Mayor upon the City Treasurer. It shall be the duty of the inspector, when called upon by any vender, purchaser, or other reputable person, or whenever he has good reason to suspect any violation of the provisions of this act, to inspect and test any refined petroleum, kerosene, or other burning fluid, by the most improved instrument. The inspector shall be entitled to receive from the person at whose request he shall make such examination, the sum of twenty-five cents for each cask, barrel, can, or other vessel inspected. From the sums so collected the inspector shall be paid for expenses incurred in carrying out the provisions of this act, and the remainder shall be paid over to the City Treasury.

Sec. 3. Any person violating any of the provisions of this act shall, upon complaint of the inspector, be subject to arrest by warrant of Court or Magistrate, and shall, upon trial and conviction, pay a penalty of not less than one hundred dollars, and not more than five hundred dollars. And in case death ensues from any violation of the provisions of this act, the party offending shall be deemed guilty of a felony, and subject to a fine of not less than one thousand dollars, and not more than five thousand dollars, or imprisonment for not less than one year, nor more than five years; the fines to be paid into the Treasury of the city where such conviction shall be had.

Sec. 4. This act shall take effect immediately.

We hail with delight the movement at Albany, which promises to do something to diminish the terrible accidents which result from dangerous kerosene.

We cut, during the year 1869, from the morning and evening paper which we read daily, the record of kerosene accidents, which resulted in

52 Deaths, mostly of women and children,
50 Serious injuries,
6 Slight injuries.

108 Sufferers.

It cannot be presumed that this list includes a tithe of the accidents which actually occur.

Not one of these accidents could have happened had the oil been of good quality.

We have now examined, at the rooms of the Board of Health, 636 specimens of kerosene purchased of retail dealers in the metropolitan district, with the following results:

Safe by both tests	21
Flash below 100° F., but do not burn below 110° F.	280
Below both tests	335
Total	636

Out of six hundred and thirty-six samples only 21 safe. Some of these dangerous oils were *naphtha*, and the dealers were not satisfied with selling this most dangerous substitute for safe oil, but they sold it as "*American Safety Gas.*" Is there any punishment severe enough for men whose cupidity is so uncontrollable that they will thus, for a few cents per gallon, risk consigning helpless women and tender children to the flames?

Though we shall rejoice to see any law enacted which will control this dangerous business, we feel called upon to point out some very important defects in the bill now before the State Senate.

1. The *burning test* is not the best test; the *flashing test* is the one that should be exclusively relied upon in testing oils. The accidents arise generally from the *vapors* which escape from the oil, and which by mingling with the air produce explosive mixtures.

Two or three per cent. of naphtha may make an oil highly dangerous in this respect, so that it will flash below 100° F., and yet its burning point may be above 110° F. Two hundred and eighty of the specimens which we tested would pass for safe oils under this law, and yet every one of them flashed below 100° F., and was liable to produce an explosion. The English law relies entirely upon the flashing point, which is fixed at 100° F.

In Section 1st the following words should be changed: "*Unless such article shall stand a fire-test of not less than one hundred and ten degrees* (110°) *Fahrenheit, as indicated by the most improved pyrometer,*" and made to read, "*which shall evolve a combustible vapor at a temperature below one hundred* (100) *degrees of the Fahrenheit thermometer.*"

2. The following provision should be included in the law: "*It shall not be lawful for any person, firm, or company to deal in, sell, or give away any* petroleum, or product of petroleum, kerosene or other oil, which emits a combustible vapor at a temperature below one hundred degrees (100°) of the Fahrenheit thermometer, except each package of the same be labelled, in clear and distinct characters, "*highly dangerous*, liable to *explode below* 100° *Fah.*" And it shall not be lawful to label, mark, or dispose of such an article under any name which can lead persons to suppose that it is intended for burning in lamps.

3. Three inspectors are entirely unnecessary for the city of New York. The positions would soon become mere sinecures. It would not be necessary to enforce the law a dozen times, to fine a few dealers, and send one or two to prison for from one to five years, to drive dangerous kerosene entirely out of the market. An inspector, if he knows his business, can easily, with one assistant, test in the most careful manner thirty or forty samples a day, or say ten thousand per annum.

I am confident five hundred or one thousand tests,

if the law was properly enforced, would drive the unsafe oils entirely out of the State.

4. The law seems to make the prosecution of offenders entirely optional with the inspector, for it says, Section 3: "Any person violating any of the provisions of this act shall, *upon complaint of the inspector*, be subject to arrest by warrant of court or magistrate," etc.

This will be a very dangerous power to put into the hands of the inspectors. It will give them an opportunity to test oils, and compound felonies without limit, in the quietest and most profitable manner possible.

The law should be made general. *Let the crime be defined, and* then let every one be entitled to enter a complaint, and simply require proof as to the flashing of the oil below 100° Fah.

Every one should be entitled to come into court and prove by competent experts the dangerous character of the oil. The inspectors should not constitute the only prosecutors, nor the only competent witnesses.

We want a law which will give us the fullest protection against kerosene accidents. And specially do we desire to avoid placing any person in a place so thickly beset with temptations as the office of an inspector under the proposed bill.

A Simple Lecture Experiment.

Having occasion to exhibit the solubility of carbonate of lime in water containing carbonic acid, we have found the syphon bottles of carbonic acid water very convenient for the purpose.

A quantity of clear lime-water is placed in a jar, and some of the carbonic acid water injected into it, when a copious precipitate of carbonate of lime is produced. On adding a further quantity of carbonic acid water, the precipitate speedily dissolves to a perfectly clear solution. The addition of ammonia causes the carbonate of lime to reappear.

Recent Chemical Patents.

Issued February 8, 1870.

99,541.—Malting Grain.—Rudolph d'Heureuse, New York.
99,588.—Manufacture of Iron, and Granulating the Same.—Wm. H. Perry, Sharon, Pa.
99,615.—Manufacture of Yeast for Distillers.—Joseph Wolff, Lexington, Ky.
99,624.—Manufacture of Steel.—J. Baur, New York.
99,628.—Preserving Fruits, Vegetables, etc.—L. Bradley and T. D. Phillips, Buffalo, N.Y.
99,637.—Treating Argillaceous Limestones to obtain Hydraulic Cement, etc.—F. Coignet, Paris.
99,728.—Process of Treating Petroleum.—J. A. Tatro, Hartford, Conn.
99,733.—Expelling Volatile Matter from Peat and other Materials.—T. G. Walker, New York.
99,735.—Cleansing Paper when Reduced to Pulp from Coloring Matters.—S. W. Wilder, Lawrence, Mass.
99,739.—Composition for Moulding Picture-Frames, etc.—Henry Wurtz, New York.
99,740.—Preparing Anhydrous Grahamite.—H. Wurtz, New York.

Issued February 15, 1870.

99,773.—Process and Material for Ornamenting Textile Fabrics.—C. Gunther, Berlin, Pussia.
99,805.—Process of Welding Cast or Bessemer Steel.—J. Absterdam, New York.
99,823.—Indigo Soap.—H. C. Borgner, Lebanon, Pa.
99,885.—Coloring Matter to be used in Vulcanized Rubber. J. Halliday, Lynn, Mass.
99,907.—Pigment for Distemper Painting.—H. M. Johnston, New York.
99,924.—Manufacture of Fertilizers and in Extracting Oils and Fats.—O. Lugo, Baltimore, Md.
99,935.—Manufacture of India-Rubber and Gutta-Percha Goods.—John Murphy, New York.
99,949.—Process and Apparatus for the Manufacture of Salt.—D. Reynolds, Albany, N. Y.
99,956.—Coloring Vulcanite or Hard Rubber.—A. D. Schlesinger, College Point, L. I.
99,975.—Manufacture of Paraffine and Paraffine Oil.—H. W. C. Tweddle, Pittsburg, Pa.
99,976.—Apparatus for Ascertaining the Amount of Acid in Liquids.—Henry Twitchell, Cincinnati, Ohio.
99,978.—Fertilizer from Glue Residuum.—A. Van Haagen and W. Adamson, Philadelphia, Pa.
99,979.—Soap Product from Glue Residuum.—A. Van Haagen and W. Adamson, Philadelphia, Pa.

Issued February 22, 1870.

100,003.—Process and Apparatus for the Manufacture of Iron and Steel.—Henry Bessemer, London, Great Britain.
100,071.—Process of Bleaching and Cleaning Vegetable Fibres.—E. T. Rice, New York.
100,095.—Deoxidizing and Carbonizing Iron Ores.—C. Adams, Philadelphia, Pa.
100,109.—Manufacture of Paper.—E. B. Bingham, Newark, N. J.
100,131.—Manufacture of Copper and in Separating other Metals therefrom.—J. B. Elkington, Birmingham, England.
100,163.—Manufacture of Fertilizers from Animal Substances.—Orazio Lugo, Baltimore, Md.
100,208.—Manufacture of Gas from Petroleum.—Levi Stevens, Washington, D. C.

Issued March 1, 1870.

100,304.—Manufacture of Pottery, etc.—Philip Marquardt, Buffalo, N.Y.
100,309.—Purification of Coal-Gas.—Emerson McMillin, Ironton, Ohio.
100,327.—Disinfecting Compound.—L. S. Robbins, New York.
100,347.—Fertilizer from Excrements.—Friedrich Wicke, Bockenheim, Julius Brouner, Theodor Petersen, and J. G. Zehfuss, Frankfort-on-the-Main, Prussia.
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100,353.—Manufacture of Dry White-Lead.—E. O. Bartlett, Birmingham, Pa.
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100,433.—Compound for the Manufacture of Illuminating Gas.—George McKenzie, Glasgow, Scotland.
100,435.—Manufacture of Hard Rubber.—John B. Newbrough, New York.
100,457.—Preparing Ammoniated Sulphuric Acid for the Manufacture of Fertilizers.—C. U. Shepard, Jr., Charleston, S.C.

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100,497.—Desulphurizing Ores.—Elizabeth A. Burns, Meadow Lake, Cal.
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100,736.—Apparatus for the Production of Ozone.—C. F. Dunderdale, New York.
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100,944.—Manufacture of Cement for Artificial Stone.—Stanislas Sorel, Paris, France.
100,945.—Manufacture of Artificial Stone.—Stanislas Sorel, Paris, France.
100,953.—Manufacture of Rosin Oil.—Joseph Treat, New York.

Reissues.

3,857.—Use and Application of Fuel in Metallurgic and other Furnaces.—J. D. Whelpley and J. J. Storer.
3,864.—Compound for Treating Hides and Skins.—L. F. Morrison, Morrisania, N.Y.
3,867.—Process of Treating Petroleum.—J. A. Tatro, Hartford, Conn.
3,873.—Manufacture of Gas.—W. S. Nichols and Alonzo C. Rand, New York.

THE CHEMICAL NEWS.
Vol. VI. No. 5. American Reprint.

ON THE TESTING OF PETROLEUM SPIRIT.

BY F. GRACE CALVERT, F.R.S., F.C.S.

I have read with much interest of late several papers on the Petroleum Act of 1868, and on the uncertainty of getting good results when testing the "flashing-point" of petroleum spirit, especially the papers published by Mr. Paul in the Chemical News and a pamphlet by Mr. Norman Tate, Liverpool. I therefore deemed it my duty to make a series of experiments, with the hope of throwing some light on the subject; the more so that the defect of the Act of 1868 is that no length of time is specified for raising the petroleum spirit from natural temperatures to its flashing-point. Thus the Act states:—

"The outer vessel shall be filled with cold or nearly cold water. A small flame shall be applied at the bottom of the outer vessel; and the thermometer shall be inserted into the oil so that the bulb shall be immersed about one-and-a-half inches beneath the surface."

What is understood by a "*small flame?*" appears to me a difficult question. Shall it be so that it will require fifteen, twenty, or thirty minutes to raise the petroleum spirit from natural temperatures to its flashing-point (say 98° or 105° F.)? The Act does not state.

The following experiments made with six samples of petroleum spirit, placed in my hands by the magistrates of Manchester, will show how important the above question is with reference to the testing of petroleum spirit, and the absolute necessity, for the safety of the public as well as for the interests of those who deal in the article, that the act should define the exact space of time that should be employed in the testing of any sample of petroleum spirit:—

Sample of petroleum spirit. at 52° F.	Time. 15 minutes.	Time. 20 minutes.	Time. 30 minutes.
No. 1	96° F.	98° F.	102° F.
" 2	92° "	99° "	101° "
" 3	90° "	98° "	101° "
" 4	94° "	96° "	104° "
" 5	96° "	98° "	110° "
" 6	95° "	99° "	108° "

These results clearly show the influence of time in raising six samples of petroleum from 52° F. to their flashing-points. Thus, when fifteen or twenty minutes are employed, the whole six samples tested could not be called "petroleum," according to the Act of 1868, and the owner would be liable to a penalty, and to the loss of the fluids; whilst, if the time employed to heat the liquid is half an hour, they would all be considered petroleums, their flashing-points being above 100° F.

Therefore, there can be no doubt that, according to the time employed, so are the results altered; the longer an operator is in completing his test, the higher will be the flashing-point of the spirit. This fact is probably due that the most volatile products gradually escape in the atmosphere, and are never in sufficient quantity to produce a "*flash*" when a taper, as described in the Act, is passed within a quarter-of-an-inch from the surface of the spirit. I am, therefore, of opinion that, as the Act has been made to protect the public against fire, or explosions resulting from the employment of too highly inflammable hydrocarbons, the chemist or person called upon to test liquids of this class should raise the temperature of the fluids under examination as quickly as possible (of course, employing the apparatus described in the Act), otherwise, they favour the vendor and manufacturer, to the detriment of the consumers.

The next series of experiments were made with a view of corroborating a statement made by Mr. Norman Tate, Liverpool, viz., if two thermometers are placed into the petroleum spirit, one, as indicated in the Act, 1½ inches below the surface of the liquid, the other thermometer only ½ an inch, a difference of several degrees will be noticed between them at the time the vapours will flash; and I am happy to say that the following results confirm Mr. Tate's interesting observations.

	1½ inches. Flashed at	½ an inch. Flashed at
No. 4	94° F	99° F.
" 5	94° "	98° "
" 6	95° "	99° "

This curious and unusual fact of a fluid having a much higher temperature near the surface than it has an inch below what may be considered as the centre of the bulk of the fluid, is due, in my opinion, that petroleum, not being a homogeneous liquid, but a mixture of several hydrocarbons, the highest products being first expelled, the heat rises towards the surface, and in this way produces the difference of temperature referred to. It was with a view of overcoming this practical difficulty that a series of experiments were instituted, in which the operations were conducted in the usual way, with this exception, that the liquid was kept in a constant state of agitation (except at the time when the flame was passed over to observe the flashing-point) by the thermometer; and the results obtained were as follows:—

No. 1 did not flash at	102° F.	
" 2 flashed at	99° F.	Fourteen minutes.
" 3 " "	98° F.	"
" 4	—	
" 5 flashed at	98° F.	
" 6 " "	104° F.	

These experiments appear to me to confirm the explanation above given on the cause which produced the difference of the two thermometers placed at unequal depths in the fluids under examination, for it will be observed that the flashing-points of the hydrocarbons are raised several degrees. In my opinion, this fact is due that agitation having facilitated the gradual escape of the most volatile products, the flash will not occur until a sufficient quantity of the more dense vapours have been volatilised and collected on the surface of the fluid to be tested.

I believe that many of the anomalies above described are principally owing to the difficulty—notwithstanding any amount of care that may be bestowed on the operation—to raise the temperature of the petroleum spirit from natural temperatures in a certain time (say fifteen, twenty, or thirty minutes) to their flashing-points. As the true flashing-points of the fluids depend entirely on the time employed in raising its temperature, I would propose the following method, which will enable every operator, in any part of the United Kingdom, to determine the flashing-point of a petroleum with cer-

[English Edition, Vol. XXI., No. 535, page 85.]

tainty, and feel satisfied that another manipulator would obtain similar results.

The process consists in heating water to 10° above the flashing-point of the spirit (approximately tested) in the outer vessel (such as described in the Act), removing the flame, and then placing the can in the water, filling it at once carefully with the petroleum spirit. The thermometer should then be placed with the bulb ½ an inch below the surface of the spirit, and the flashing-point then ascertained in the usual manner. The following are the results I obtained with the same six samples of petroleum which I employed in my previous experiments:—

	First experiment.	Second experiment.
No. 1	flashed at 98·0° F.	99° F.
" 2	" 95·0° "	96° "
" 3	" 96·0° "	97° "
" 4	" 96·0° "	97° "
" 5	" 96·5° "	97° "
" 6	—	—

I am also of opinion that a gas-flame should be employed, in preference to a spirit-lamp, when the test is made in a similar manner to the directions given in the Act, as greater regularity in the rise of temperature can be secured. I have also used in my experiments (and I advise every one to do so) the excellent suggestion made by Mr. Norman Tate—viz., a small gas-flame, instead of that produced by a match or taper, for testing the flashing-point of the spirit.

I consider the apparatus proposed by Mr. Miles would tend to give certainty to the assay, which, at the present time, cannot be satisfactorily performed. The above experiments prove that the Petroleum Act of 1868 does not give sufficient and precise instructions for the testing of petroleum spirit. Therefore it is to be hoped that Government will again take the matter in hand, and do away with the objections of the present Act, substituting more clearly defined rules and instructions, to enable the operator to determine the flashing points of petroleum spirit with greater accuracy.

ON A

NEW STEP IN THE PROXIMATE ANALYSIS OF SACCHARINE MATTERS.*

BY JAMES APJOHN, M.D.,

PROFESSOR OF CHEMISTRY AND MINERALOGY IN THE UNIVERSITY OF DUBLIN.

The proximate analysis of crude sugars and syrups is a problem of practical importance, and also one of considerable difficulty, as such generally include not only cane sugar, but, in addition, two other varieties of saccharine matter—viz., inverted sugar, and crystallized glucose, commonly called grape sugar. The amount, indeed, of the cane sugar admits, as is well known, of being readily determined by an optical method, in which we may employ Soleil's saccharometer, the previous saccharometer of Biot, or the much more sensitive instrument for which the scientific world is indebted to Professor Jellett. By taking, with one or the other of these instruments, the rotative power on plane polarized light of the saccharine material under consideration, both before and after it has been inverted by digestion with an acid, we obtain data from which, and certain constants, the required information may be deduced. If, for example, separate solutions of the three sugars already named be made, containing 416 grs. in 10 cubic inches, the rotative powers of a column of each 20 centimetres (7·87 inches) long, when measured on the French instrument (with the use of which I am most familiar) are known to be—

For cane sugar	100°
" inverted sugar	36° at 59°
" grape sugar	76°

The rotative powers, therefore, of a single grain of each sugar made into syrup having the bulk already mentioned, and observed in the same tube, will be—

Cane sugar	0·240
Inverted sugar	0·086
Grape sugar	0·182

Hence, the observed rotation before inversion being θ, and after inversion θ', and x, representing the quantity of cane sugar, y, of inverted sugar, z, of grape sugar, we arrive at the two following equations, in which it will be noted that the rotation produced by the inverted sugar has a negative sign, and that the coefficient of inversion of the cane sugar is 0·36 (Jellett) at 59° F.

$$x \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta \qquad (1)$$

$$-x \times 0{\cdot}24 \times 0{\cdot}36 = y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta' \qquad (2)$$

And subtracting the second of these equations from the first, we get—

$$x \times 0{\cdot}24 + x \times 0{\cdot}086 = \theta - \theta'$$

$$x = \frac{\theta - \theta'}{0{\cdot}326} \qquad (2)$$

Very important information is thus rapidly obtained, for the most valuable constituent of any crude saccharine substance is the cane sugar which it includes. But the analysis is imperfect, for we do not learn from it the quantity of either of the two other sugars, nor even their aggregate amount, for this cannot be got by subtracting the cane sugar already determined from 416 grs., as much of the difference is water, and in many cases *its* estimation cannot be accurately effected by any process of drying.

And here it may be observed, that by chemistry alone, and without any assistance from optical science, we can advance a step further than the saccharometer conducts us. We can, for example, reduce Barreswill's solution of copper with a syrup both before and after inversion. The latter experiment gives us the entire of the three sugars; the former, the sum of two of them, the inverted and grape sugar, while the difference of the results of the two experiments will correspond to the cane sugar. The chemical then goes a little beyond the optical method, for it not only tells us how much cane sugar is present, but, in addition, informs us of the exact aggregate amount of the two other sugars. Further than this it does not go; and we are still unable to assign the exact quantities of inverted and of cane sugar which may be present.

I have now to mention that, in conversing with Professor Jellett on this subject, he threw out the observation that, by combining the chemical and optical methods of experiment, the difficulty just alluded to might possibly be overcome, and the analysis rendered complete. Attaching much importance to his opinion

* From the *Transactions of the Royal Irish Academy*, vol. xxiv.—Science. Read December 13th, 1869.

on such a question, I turned the matter carefully in my mind, and soon found that his suggestion was quite correct, as will appear from the following explanation:—

By the optical method already adverted to, and with which physicists are long familiar, we obtain the quantity of the cane sugar; and by *inverting* the syrup, and applying it to the Barreswill's solution, we can get the entire amount of the three sugars, each being estimated on the hypothesis (we shall say) of its being grape sugar. The equations derivable from these two experiments are—

$$x \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = \theta \qquad (a)$$
$$x \times 1{\cdot}16 + y \times 1{\cdot}1 + z = w, \qquad (b)$$

the first being the equation, already explained, which gives the rotative power of the syrup; the second, that which expresses the amount, w, of the three sugars, which, after *inversion*, has been estimated by the *blue solution*. The numerical coefficients in the former equation are, as previously stated, the unit *rotation* powers of the respective sugars, while, in the latter, 1·16 is the ratio of the half atomic weight of cane sugar to that of the atom of grape sugar; and 1·1 is the ratio of the atomic weight of *inverted* to that of grape sugar. Now, as by the optical experiment the amount of the cane sugar, x, has been determined, the first term in each of the equations is known, so that, as there are now only two unknown quantities, y and z, the value of each may be determined.

I have applied this method, on several occasions, in the proximate analysis of crude sugars and syrups, and with satisfactory results. The details of a single experiment recently made will be sufficient here. In operating on the variety of molasses called *golden syrup*, its *rotative* powers, as given by Soleil's instrument, were found to be as follows:—

Before inversion	38·35°
After inversion	−12·15

Results from which we find, by equation (3) already given, the quantity of cane sugar in 416 parts of the syrup to be 154·95 grs. The second, or chemical experiment, was then made, which consisted in *inverting* 34·3 grs. of same syrup, and operating upon it with Barreswill's solution, which showed that the 34·3 grs. included 24·75 grs. of saccharine matter estimated as grape sugar, corresponding to 297·26 grs. from 416 of the syrup. Replacing, then, x, in equations (a) and (b) by its value, 154·9, and substituting in them 38·35 for θ, and 154·9 for w, they become—

$$154{\cdot}9 \times 0{\cdot}24 - y \times 0{\cdot}086 + z \times 0{\cdot}182 = 38{\cdot}35 \qquad (a)$$
$$154{\cdot}9 \times 1{\cdot}16 + y \times 1{\cdot}1 + z = 297{\cdot}26 \qquad (b)$$

These equations involve only two unknown quantities, and therefore admit of solution, and when worked out we find—

$$y = 70{\cdot}66$$
$$z = 39{\cdot}89$$

so that the final numbers at which we arrive are the following, the figures in column (1) referring to 416 grs. of the syrup, and those in column (2) being percentages.

	(1)	(2)
Cane sugar	154·95	37·17
Inverted sugar	70·63	16·95
Grape sugar	39·87	9·57
Water and other inactive matters	150·55	36·31
	416·00	100·00

The 36·31 parts set down as water are got by difference. I may, however, observe, that by the direct process of drying *in vacuo* over oil of vitriol only 22 per cent could be obtained, so that it is possible that some gummy matter may be present. Its amount cannot exceed 14·31 per cent, and it is probably much less, as the perfect expulsion of moisture from syrup is, as already observed, a thing very difficult of accomplishment.

I must not close this short paper without stating that the optical observation which gives θ' is one which it is difficult to make with the necessary degree of precision, for, though the syrup may be clarified by animal charcoal, in the process of inversion it invariably acquires a greater or less degree of color. Fortunately, however, it is not necessary to make any optical experiment on the inverted syrup, for the object of such experiment is to enable us to calculate the amount of the cane sugar, and this can be done in a different way. It is, in fact, quite sufficient, as already explained, to apply Barreswill's solution, not only after inversion, but before it; and the difference of the two results will correspond to the cane sugar present in the syrup. The equations which express the results of these two experiments are the following:—

$$\text{Before inversion, } y \times 1{\cdot}1 + z = w', \qquad (m)$$

w' being the grape sugar corresponding to y and z.

$$\text{After inversion, } x \times 1{\cdot}16 + y \times 1{\cdot}1 + z = w, \qquad (n)$$

w being grape sugar, corresponding to x, to y, and to z. From which we deduce—

$$x = \frac{w - w'}{1{\cdot}16},$$

In working upon this plan with 100 grs. of the specimen of molasses already mentioned, the following results were obtained:—

$$w' = 30{\cdot}64. \qquad w = 72{\cdot}87.$$

From which *data* we find—

$$x = \frac{72{\cdot}87 - 30{\cdot}64}{1{\cdot}16} = 36{\cdot}44,$$

a number approximating closely to 37·17, the percentage of cane sugar as determined by the saccharometer.

From equation (m), too, we learn that the inverted sugar multiplied by 1·1, with the addition of the grape sugar, amounts to 30·64 grs. But by the conjoint aid of the saccharometer and the blue solution, it has been already shown that $y = 16{\cdot}95$, and that $z = 9{\cdot}57$, so that $y \times 1{\cdot}1 + z = 28{\cdot}21$.

There is manifested here, it must be admitted, an appreciable amount of divergence; for, instead of the chemical and optico-chemical methods of assay being in harmony with each other, we find that a result given by the former exceeds the corresponding one given by the latter by 2·43 per cent. The cause of this discrepancy it is not difficult to assign. It must obviously proceed from the presence in the molasses of some principle or principles different from either cane, inverted, or grape sugar, and which themselves exercise circular polarisation, and, mayhap, also exert a reducing action on Barreswill's blue solution. The substances of this nature, which may possibly be associated with the sugars in saccharine juices, are dextrin, asparagin, and tartaric acids; and when any such do

exist in a saccharine product, its *exact* proximate analysis is rendered extremely difficult, if not impracticable. It is, therefore, scarcely necessary for me to state here that the optico-chemical process explained by me in this paper, will only give perfectly accurate results when applied to a mixture of cane, inverted, and grape sugars, in which no other *active* principle is contained. I may, however, add that the sugars just enumerated constitute the great bulk of all known saccharine products, and that, when other matters are present which complicate the problem, they are usually in such minute quantity as not to interfere materially with the success of my method when applied generally to the proximate analysis of saccharine products.

ON THE

ALLEGED SOLUBILITY OF GLYCERINE IN CHLOROFORM.

BY HARRY NAPIER DRAPER, F.C.S.

In Watts's "Dictionary" (vol. ii., p. 887), it is stated that "glycerine dissolves in all proportions in chloroform;" and, at p. 889, a process is actually quoted for the detection and estimation of cane-sugar and glucose in glycerine, based upon the assumption of this solubility. The same method (apparently quoted from the same source) is also given in the Chemical News (vol. viii., p. 227; *Eng. Ed.*).

It is not easy to conceive how Palm, who is the authority quoted by Watts for the analytical method, can have been misled by the somewhat easy *miscibility* of glycerine with chloroform to suppose that it was soluble in that body.

The following experiments were made with Price's glycerine, which had been kept for an hour at 136° C., and was then allowed to cool out of contact with the air.

(*a*). Equal volumes of glycerine and chloroform were shaken together in a graduated tube, and then allowed to rest. The two fluids completely separated, and their relative volumes were found to be unaltered.

(*b*). Ten c.c. of glycerine and 100 c.c. of chloroform were violently agitated together, and the mixture poured upon a filter moistened with chloroform. The liquid which passed through was then evaporated upon a water-bath. It left no residue.

(*c*). Experiment (*b*), repeated with boiling chloroform, gave an equally negative result.

I deduce from these experiments the conclusion that glycerine is absolutely insoluble in chloroform; and that, on the other hand, glycerine does not dissolve chloroform; and, as the chemical properties of all glycerines hitherto examined are alike, the statement in "Watts" must be considered incorrect, and the process of Palm as having no value.

Dublin, Feb. 15th, 1870.

ACTION OF

CHLOROSULPHIDE OF PHOSPHORUS UPON ALCOHOL.

BY M. CHEVRIER.

The only enquiries relative to this subject were made by M. Cloëz, who, in 1847, prepared sulphoxyphosphovinic acid, and several of its salts, and, ten years later, examined the action of $PSCl_3$ upon soda-alcohol, and obtained ethylsulphoxyphosphoric ether. His two notices are very short. The first contains no details of the secondary products of the reaction, which, moreover, is not formularised.

This subject has been my study, which was also extended to amylic alcohol.

The action of chlorosulphide of phosphorus upon alcohols is sufficiently complex; nevertheless, with care, it may be easily regulated, and the same products always obtained in the same proportions. (The only alcohols here alluded to are monatomic alcohols, corresponding with the fatty acids.) With the first terms of the series (methylic and ethylic alcohols), the action is very lively; but it is less so in the case of more distant terms—such as amylic alcohol. In all cases, the result is a compound acid—the chloride of the alcoholic radical, with evolution of chlorhydric acid, which may be easily collected, so as to allow of the reaction being formularised.

In the case of ordinary alcohol, the reaction is produced between 1 equiv. of chlorosulphide and 3 of alcohol.

$$PSCl_3 + 3\left(\begin{matrix}C_2H_5\\H\end{matrix}\right\}\Theta\Big) = \left.\begin{matrix}(PS)'''\\C_2H_5\\H_2\end{matrix}\right\}\Theta_3 + 2C_2H_5Cl + HCl.$$

By means of a special arrangement of the apparatus, all the chlorhydric acid and almost all the chloride of ethyl may be collected. The phenomenon is at all times more complex than the preceding equation would indicate; a small quantity of sulphur is precipitated, and a corresponding amount of ethylphosphoric acid is formed.

Ethylsulphoxyphosphoric acid is an oily liquid, heavier than water, which will not dissolve it, and having a nauseous odour. It is decomposed by dry distillation.

Soda-alcohol. The chlorosulphide, $PSCl_3$, reacts vigorously on soda-alcohol, and yields the corresponding ether discovered by M. Cloëz. All the chlorine of the $PSCl_3$ is fixed upon the sodium in the alcohol. The formula of the reaction is—

$$PSCl_3 + 3\left(\begin{matrix}C_2H_5\\Na\end{matrix}\right\}\Theta\Big) = 3NaCl + \left.\begin{matrix}(PS)'''\\3(C_2H_5)\end{matrix}\right\}\Theta_3$$

Ethylsulphoxyphosphoric ether is a colourless, oily liquid, insoluble in water, with an odour of rotten beet-root quite as disgusting as that of the corresponding acid. It can only be distilled in a current of steam.

Amylic alcohol. This may be slowly attacked at the ordinary temperature by chlorosulphide of phosphorus. The reaction is facilitated by stirring the mixture, to lessen the viscosity, and heating it in a water-bath. Abundant evolution of chlorhydric acid ensues, with formation of chloride of amyl and amylsulphoxyphosphoric acid. These two liquids are separated by heating the mixture to 105°. The residue is redissolved in alcohol, to separate the small quantity of sulphur, and then heated to 100°. The liquid thus obtained is oily, lighter than water (in which it is insoluble), and soluble in alcohol. It is decomposable by dry distillation at about 145°, but is easily distilled in a current of steam. One of its salts was prepared.

Alkaline amylsulphoxyphosphates and the baryta salt are very soluble in water. They are greasy to the touch, like all salts which contain the radical, C_5H_{11}, of amylic alcohol. The formula of the soda salt is—

$$\left.\begin{matrix}(PS)'''\\C_5H_{11}\\Na_2\end{matrix}\right\}\Theta_3$$

That of baryta corresponds to—

$$\left.\begin{matrix}(PS)'''\\C_5H_{11}\\Ba_2\end{matrix}\right\}\Theta_3 + Aq.$$

The copper salt is of a greenish-blue colour. It may

be used to prepare amylsulphoxyphosphoric acid, by treating it with a current of sulphuretted hydrogen. The crystals of amylsulphoxyphosphates produce very easily the phenomenon of epipolism. When thrown into perfectly pure water, they turn about like camphor until completely dissolved; the least trace of fatty matter will, however, stop the gyratory movement. Epipolic power was ascertained to be present in sundry crystals containing the radical amyl, particularly the sulphamylate of baryta: crystals of phenic acid are similar in this respect.

Amylate of Soda.—The action of $PSCl_3$ on amylate of soda is very energetic. The sodium alcohol is placed in a retort or spherical receiver, and the liquid added to it, drop by drop. The products of the reaction are then treated with water, which dissolves the chloride of sodium formed, and separates an oily liquid, which collects on the surface; this is amylsulphoxyphosphoric ether, a colourless liquid, which in time becomes slightly greenish. It distils in a current of steam, without decomposition. Its density at 12° is equal to 0·849. Its degree of refraction corresponding to the yellow ray of sodium is equal to 1·42. Reaction occurs between 1 equiv. of chlorosulphide and 3 of amylate of soda, as with common alcohol.

$$\left.\begin{matrix}(PS)'''\\ Cl_3\end{matrix}\right\} + 3\left(\begin{matrix}C_5H_{11}\\ Na\end{matrix}\right)\Theta\Big) = \left.\begin{matrix}(PS)'''\\ (C_5H_{11})_3\end{matrix}\right\}\Theta_3 + 3NaCl.$$

In the case of monoatomic alcohols represented by the general formula—

$$\left.\begin{matrix}C_nH_{2n+1}\\ H\end{matrix}\right\}\Theta$$

the chlorosulphide of phosphorus gives the corresponding combined acid—

$$\left.\begin{matrix}(PS)'''\\ C_nH_{n+1}\\ H_2\end{matrix}\right\}\Theta$$

the chloride of the alcoholic radical $C_nH_{n+1}Cl$ and of chlorhydric acid. Whilst reacting upon the metallic derivatives of these alcohols—

$$\left.\begin{matrix}C_nH_{2n+1}\\ M\end{matrix}\right\}\Theta$$

the chlorosulphide $PSCl_3$ produces an ether analogous to the fatty bodies, represented generally by—

$$\left.\begin{matrix}(PS)'''\\ 3\,(C_nH_{2n+1})\end{matrix}\right\}\Theta.$$

If the kind of decomposition to which chlorosulphide of phosphorus is subject in the presence of those simple or compound bodies upon which its action is exercised be carefully examined, it will be seen that its action is at the same time chlorising and sulphurising. The triatomic radical $(PS)'''$ has a remarkable tendency to substitution in compounds.

All oxygenated compounds which yield the oxychloride $P\Theta Cl_3$ form corresponding sulphuretted compounds furnished by chlorosulphide $PSCl_3$. This liquid constitutes an excellent reagent for the substitution of sulphur for oxygen.

ON MICROSCOPICAL MANIPULATION.*

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Amer. Repr., April, 1870, page 187.)

In the following lessons, the possession of an instrument fitted with Mr. Wenham's stereoscopic binocular arrangement has been supposed. As microscopes of moderate price are now so constructed, the author has no hesitation in arranging the following simple course of exercises more especially for its use; nearly all the observations can, however, be made with the monocular instrument.

The following tables, containing lists of the objectives made by the three principal London opticians, with their approximate magnifying powers and angles of aperture, may assist the student in selecting a glass suitable for the object to be examined. It must be borne in mind that the powers given are those of the lenses when used upon the stands of their respective makers; the length of the body materially influences the power of the combination, as will be seen by the table for the use of the draw-tube given in Messrs. Beck's list:—

R. AND J. BECK.

Focal length.		Linear Magnifying Power (nearly) with Eye-Pieces. 1	2	3	4	5	Angle of Aperture about
3 inches.	Draw-tube closed	12	20	40	48	74	12 degs.
	Do. if drawn out, add for each inch	2	4	6	7	10	
2 "	Draw-tube closed	20	38	70	85	130	18 "
	Do. if drawn out, add for each inch	4	6	8	12	15	
1½ "	Draw-tube closed	30	56	100	120	190	23 "
	Do. if drawn out, add for each inch	5	7	12	15	22	
⅔ "	Draw-tube closed	70	120	220	270	410	32 "
	Do. if drawn out, add for each inch	8	14	25	27	48	
1/5 "	Draw-tube closed	120	210	370	460	710	55 "
	Do. if drawn out, add for each inch	14	24	34	46	70	
1/5 "	Draw-tube closed	146	255	460	560	890	90 "
	Do. if drawn out, add for each inch	18	32	48	60	80	
¼ "	Draw-tube closed	200	340	590	720	1120	75 "
	Do. if drawn out, add for each inch	24	42	63	85	120	
1/6 "	Draw-tube closed	225	400	700	860	1450	85 "
	Do. if drawn out, add for each inch	18	35	60	80	130	
1/6 "	Draw-tube closed	225	400	700	860	1450	100 "
	Do. if drawn out, add for each inch	18	35	60	80	130	
⅛ "	Draw-tube closed	500	870	1500	1850	2800	120 "
	Do. if drawn out, add for each inch	60	100	180	190	370	
1/20 "	Draw-tube closed	900	1570	2750	3450	4950	140 "
	Do. if drawn out, add for each inch	80	150	300	350	900	

* The substance of a course of lectures delivered to the members of the Quekett Microscopical Club, January—April, 1869. This and the following articles contain such portions of the demonstrations after the lectures as could not conveniently be incorporated with the preceding text. Much new matter has also been added.

THOMAS ROSS.

Object Glasses.	Angular Aperture.	Magnifying Powers with the various Eye-Pieces.					
		A	B	C	D	E	F
5 inches	7 degs.	8	13	24	36	52	72
4 "	9 "	10	16	30	45	65	90
3 "	12 "	13	20	35	56	84	112
2 "	15 "	20	32	55	90	135	180
1½ "	20 "	25	40	70	112	168	224
1 "	15 "	37	60	105	170	255	340
1 "	25 "	37	60	105	170	255	340
⅔ "	35 "	60	100	145	270	405	540
⅓ "	90 "	95	153	265	420	630	840
1/10 "	110 "	140	220	370	650	975	1300
¼ "	100 "	195	310	540	850	1275	1700
¼ "	140 "	195	310	540	850	1275	1700
1/6 "	140 "	320	510	700	910	1360	1820
⅛ "	140 "	420	670	900	1200	1800	2400
1/12 "	170 "	600	870	1200	2000	3000	4000

POWELL AND LEALAND.

Object Glasses.	Angular Aperture.	Magnifying Power with the various Eye-Pieces.				
		1	2	3	4	5
2 inches	14 degrees	25	37	50	100	150
1½ "	20 "	37	56	74	150	220
1 "	30 "	50	74	100	200	300
⅔ "	32 "	75	111	150	300	450
½ "	70 "	100	148	200	400	600
1/10 "	80 "	125	187	250	500	750
¼ "	95 "	200	296	400	800	1200
"	130 "	—	—	—	—	—
"	145 "	—	—	—	—	—
1/6 "	100 "	250	370	500	1000	1500
⅛ "	140 "	400	592	800	1600	2400
1/12 "	145 "	600	888	1200	2400	3600
1/16 "	175 "	800	1184	1600	3200	4800
1/25 "	160 "	1250	1850	2500	5000	7500
1/50 "	150 "	2500	3700	5000	10000	15000

The screws cut upon the nozzles of microscopes, and upon object-glasses, are now common among English opticians, so that the objectives may be attached to any stand at pleasure.

The following symbols will be employed to indicate the apparatus to be used.

Object-Glasses—

4 in. or 3 in.	03
2 " 1½ "	02
1 " ⅔ "	01
½ " 1/10 "	01½
¼ " 1/5 "	01¼

Higher powers, 0, with the fraction indicating the nominal focal length.

Eye-Pieces.—When no symbol is used, the lowest power, viz., No. 1, or A, is supposed; medium power, E 2; deeper, E 3; return from deep eye-piece to one of lower power, E.

The binocular prism is supposed to be employed in general; when it is to be withdrawn, and the instrument rendered monocular, M is used; the return to the binocular is indicated by B.

The illuminating apparatus first mentioned is that to be used if possible; that following, between brackets, may be used as a substitute.

The apparatus and materials constantly required, besides the microscope, are—

Lamp (vol. xx., p. 158).—A glass stage-plate; easily made by attaching a narrow slip of glass, with marine glue (vol. xx., p. 171), to a glass plate of convenient dimensions, so as to form a ledge, and prevent objects slipping off when the stage is inclined.

Some 3 × 1 slides; a small stock of thin cover glass, in squares and circles; forceps; needles mounted in handles (vol. xx., p. 182); a few pipettes (vol. xx., p. 170), and some blotting paper; a small quantity of alcohol and turpentine; and also a supply of water should be at hand.

The following books, being often referred to, will be quoted with abbreviated titles:—

Carpenter.—"The Microscope and its Revelations," by W. B. Carpenter, M.D. (4th edition, 1868.)

Beale.—"How to Work with the Microscope," by Dr. L. S. Beale, F.R.S. (1868.)

Hassall.—"Adulterations Detected," by A. H. Hassall, M.D.

Lesson I. On the Use of the Condensing Lens and Mirror.

Material for Examination—White Blotting-Paper.

Arrange the microscope at a comfortable inclination, and adjust the draw-tubes of the eye-pieces to suit the distance between the eyes. Screw on the objective, 01; in doing this, hold the glass within the nozzle of the microscope with the first and second fingers of the left hand, while it is screwed in with the finger and thumb of the right. Do not leave go with the left hand until the screws have good hold; observe the same precaution in unscrewing; never risk the fall of an object-glass.

Tear with the forceps (not cut) a minute fragment from the edge of a piece of blotting-paper; place it upon the glass stage-plate, and bring it, as nearly as can be judged, under the centre of the object-glass, which should be well raised above the stage. Place the lamp on the left of the microscope, at a height about half way between the stage and eye-piece, and direct the light upon the paper with the condensing lens (vol. xx., p. 159; *Am. Repr., Dec.* 1869, *page* 323). Bring the object-glass down, by means of the coarse adjustment, nearly to the working distance of the objective; this is always considerably shorter than the nominal focal length; with 01 it may be a little more than half an inch. After a little practice, the student will learn the proper distance for each glass; until this is acquired, it is best to proceed cautiously, to avoid injury to the object, especially when high powers are used.

Now look through the instrument; adjust the position of the object, with the fingers or stage movements, until it occupies the centre of the field; bring it accurately into focus with the coarse adjustment; and alter the position of the condensing lens and of the lamp, if necessary, so as to obtain the most perfect illumination.

The paper will be found to consist of interlaced fibres, which are seen to the best advantage at the edges, where they are frayed out; hence the direction to tear. This applies in numerous cases, a laceration or fracture sometimes revealing points of structure in a manner not easily demonstrated by other means.

When the object has been fully examined, remove the condenser, open the large aperture in the wheel of diaphragms beneath the stage, lower the lamp upon its stem into a convenient position for lighting the concave mirror, and direct the convergent pencil upon the object. It will be found that the view now ob-

tained is in every respect inferior to that by reflected light; this is owing, partly to the opacity of the paper, and partly to the different densities of the object and of the medium in which it is viewed. If a higher power, O4, M, is used, the result will be much worse; this kind of view is that obtained by beginners, who usually try to examine every object by transmitted light, and but rarely use other and better means of illumination. Change the power to O1, B; place a drop of water on the object with a pipette (or the tip of the finger); cover with a thin glass; absorb any surplus moisture with blotting-paper; replace the slide on the stage; and adjust the focus. The confused appearance of the edges has now disappeared, and the light to some extent penetrates the central portions of the object. With the binocular, the full light from the mirror will be found to produce an unpleasant glare, and the white cloud illumination (vol. xx., p. 265; *Am. Repr., Feb.* 1870, *page* 53) may be substituted with advantage. Still, little beyond the fibres at and near the edges can be well made out. Remove the slide from the stage; take off the cover, and with a pair of mounted needles tear up and spread out the moistened paper; replace the cover, and examine as before. All the structure will now, probably, be seen; if not, tear the object up still more, until the result is satisfactory. Higher powers may now be used with advantage, taking care to make the requisite correction for the aberration caused by the cover glass (vol. xx., p. 169; *Am. Repr., Dec.* '69, *page* 324), should the objective be provided with the proper adjustment. With the glasses O½, O¼, and higher powers, it will be desirable to employ the fine adjustment in completing the focussing, and during the observation. Until the beginner has had some experience, it will be best to use O½, in preference to a higher power, as the risk of damaging the object, or object-glass, is lessened; after a time, the use of glasses of short working distance will become easy. In removing a slide from the stage when a high power is employed, raise the body to some distance, to prevent accidental contact with the front lens, as it might be scratched or otherwise injured.

Try the effect of viewing some more torn up fragments in other media, such as oil, turpentine, or glycerine. Mount a specimen in balsam (vol. xx., p. 207; *Am. Repr., Dec.* 1869, *page* 329), taking care that the paper has been well saturated with turpentine, to remove air bubbles.

These experiments may be repeated with other kinds of paper, and their different degrees of compactness noticed. The determination of the material of which the paper is composed had better be deferred until Lesson VI. has been studied.

Arrange the microscope and lamp for the use of the condensing lens; as before, use O1, B; make a few marks, with a soft black-lead pencil, on a piece of blotting-paper, and notice the disposition of the particles of plumbago among the fibres. Examine ink marks; printing from plate (a visiting card will do); likewise specimens of surface-printing, as wood engraving or type, and also lithographs. Notice the varying manner in which the ink is distributed.

Repeat the experiments with the light on the right hand, and also in front. Although it is most convenient to place the lamp on the left, because it is out of the way of the right hand moving and adjusting the object in the stage, yet it may sometimes be required to place the light elsewhere; and the student should be able to work with it in any situation. Practice by daylight should not be neglected whenever opportunities offer.

Try, also, the effect of using different eye-pieces. When a complete series of objectives is not at hand, an awkward interval of magnifying power may often be thus filled up (see Tables, vol. xxi, p. 89; *Am. Repr., May*, 1870, *page* 233). In drawing, it is often useful to make the object fill the field; this can generally be done by a suitable change of eye-piece.

Lesson II.

Material for Examination—Dirt from Sponges.

This can be obtained in any quantity from dealers. It accumulates at the bottom of the boxes in which sponge is imported.

Arrange the microscope as in the former lesson, O2, Illuminator. Parabolic Lieberkuhn or [*Condensing-Lens*].—If artificial light is used, render the rays parallel (vol. xx., p. 255) before they are reflected from the lieberkuhn.

Spread a small portion of the substance over the stage-plate.

The specimen will most likely be found to consist chiefly of sand, which prevents a good view of the other substances in it being obtained, although, here and there, some objects may be seen. The sand may be removed by sifting through a piece of wire-gauze, of about 40—50 threads to the inch; or a series of sieves may be used, if it is wished to carry out the sorting to a greater extent. Examine some of the coarse residue as before. The principal contents will be coarse sand and fragments of rock, fibre, abraded splinters of wood, seaweed, fragments of *Echinus* spines, skeletons of various *Hydrozoa* and *Polyzoa* (vulg., *Zoophytes*), sponge, spicules, and shells.

Separate the shells and other objects that may be required for further study; this may be done by picking them up with a small camel-hair pencil, moistened and drawn to a point. Small pill-boxes or homœopathic-bottles make convenient receptacles for keeping these objects in, when sorted. A pocket-lens mounted on a stand, or a watchmaker's glass will afford sufficient magnifying power. If the light is concentrated upon the substance to be examined with the condensing-lens, and black paper used to spread the sand on, a great deal may be done without using the glass at all. For dissecting and more delicate operations of this kind. Beck's 3-inch binocular magnifier will be found useful: it is, in effect, a pair of achromatic spectacles of considerable power, and fatigues the eyes less in prolonged operations than the use of a single lens. A more complete binocular dissecting is described in "Carpenter," p. 54.

Select some of the shells resembling small nautili (*Foraminiferæ*), and make arrangements for examining them in varied positions with Disc-holder (vol. xx., p. 193) or [*stage-forceps*]. Observe the peculiar structure of the part where the mouth of an ordinary univalve-shell (*Gasteropoda*) usually is, closed with a perforated plate, instead of being open. Also, in some species, perforations will be observed on the sides of the shells: hence the name of the group *Foraminiferæ*. Mount some of the shells dry in various positions (taking especial care that the mouth is well displayed), label, and preserve for reference.

Bed some of the shells in balsam (vol. xx., p. 208), and grind away the surface so as to expose the interior; carefully polish, and remove the balsam. This

process will reveal the chambered internal structure, which varies extremely in different species. An increase of power may now be used with advantage (O1, or O½ if the illuminator for this higher objective is accessible). With such augmented power, the minute shell-structure may be observed; but this can be accomplished more readily by grinding a thin section, which will admit of examination with higher powers and the paraboloid or achromatic condenser. These thin sections can be ground by a process devised by Dr. Wallich (*Ann. Nat. Hist.*, July, 1861; also "Carpenter," p. 192, note). The shell is to be fastened to a thin plate of mica, in the first instance, and this, with the shell upwards, is to be cemented to the plate of glass on which it is held during the process. One side is ground and polished in the usual manner. The slide is then warmed, which permits the removal of the mica plate with the half-finished section attached. The shell is then cemented by its polished side to another grinding-plate, and completed in the usual manner. The plate of mica is easily ground away, and offers no impediment to the cutting of the shell. The resulting section is to be mounted, either dry or in balsam, as circumstances may require.

Foraminiferæ and other shells abound in deep-sea soundings. As usually obtained from this source, they are mixed with the tallow placed at the bottom of the lead to bring up the sample; this grease must be removed by solution in benzol. *Foraminiferæ* and other fossils may be separated from chalk by processes described in Lesson 3.

For further information respecting the *Foraminiferæ*, see art. *Foraminiferæ*, "Micrographic Dictionary," p. 292; "Carpenter," pp. 482—523; Greene's "Manual of the Protozoa"; Williamson and Carpenter's Monographs (Ray Society).

Lesson III.

Specimens Required — Flour, Starch (Arrow-root, Potato-Starch, or Brown and Polson's Corn Flour), Chalk (in Lump, not Whiting or Washed Chalk), Powdered Lump-Sugar, and Common Table-Salt.*

Examine by placing a minute quantity of each of these white powders on the stage-plate, and examine with O1, by reflected light, as in preceding lessons. Notice the different appearances of each. The flour will be found to contain numerous rounded, glittering bodies (starch granules), mixed up with a quantity of matter not easily defined with the power employed. The starch consists entirely of these shining substances, which, in the larger kinds, as "Tous-les mois," cause a distinct glittering appearance without any optical aid, if examined in a good light. The chalk is apparently structureless. The sugar and salt exhibit numerous crystals, more or less broken.

The student will do well to examine the solubility of these substances, by shaking a little of each in a test-tube, with water. Small portions should also be heated to redness, on a slip of platinum foil, in the flame of a spirit-lamp. The flour and starch will be carbonised and burnt to an ash, if the heat is long continued. The chalk will still remain white. The sugar will melt, and then carbonise. The salt will decrepitate or crackle, and bound off the platinum.

These simple chemical examinations should not be neglected by the microscopist, especially when examining unknown substances. Some skill in the use of the blowpipe may occasionally be of service. Solubility of a substance in water or other fluids may be tested under the microscope, and with the advantage that very small quantities are sufficient for experiment. Other reagents may also be employed. "Beale," p. 201.

Flour and Starch.—Place a little of the starch and flour on separate slides, with a drop of water; stir up with the point of a knife or needle, to diffuse the particles; cover with thin glass, and view with same power, first with dark-field illumination, and afterwards by transmitted light. Then use O¼M by transmitted light. The flour will be seen to consist of the before-mentioned rounded bodies, with a small admixture of fragments of membrane, cell, wall, &c. These are best seen in meal made by crushing or grating a grain of corn, as flour in general is too finely sifted to contain much of these textures. The slide of starch will exhibit the same rounded bodies, starch granules. They are best studied in a large-grained kind, such as *Tous-les-mois*,* the product of *Canna edulis*. With O¼M and transmitted light, a number of concentric rings will be seen, surrounding a spot known as the *hilum*. Microscopists differ respecting the nature of these markings (see article *Starch*, "Micrographic Dictionary," p. 657; "Carpenter," p. 399). Examine with *polariscope* O1, and, if possible, with higher powers. Notice the characteristic black cross, having its centre at the hilum. In oat-starch the black cross is wanting, the grains are polygonal, and clustered in rounded masses. Test the contents of the slides with a solution of iodine in water, made by placing a small crystal in distilled water. When it has acquired a straw colour, it will be of sufficient strength; only a minute quantity will be dissolved. A small drop of this reagent is to be placed at the edge of the cover with a pointed pipette, or, better, with one of the test-bottles with perforated conical stoppers. When the iodine reaches the starch granules, they will be stained of a violet colour. This and the polarisation test will readily distinguish starch granules from other round bodies. A series of starches from various plants should be mounted, and kept for comparison. Two slides of each should be prepared, one dry, the other in balsam, for examination with the polariscope. When starch is mounted in balsam, care should be taken to employ as little heat as possible. Starch granules are not well preserved in fluids. Starch may be separated from flour by making it into a stiff paste, tying it in a muslin bag, and kneading in water. The gluten will be left in the bag, and the starch will fall to the bottom of the vessel, and can be cleaned by washing and decantation of the supernatant fluid. Roots, &c. (as potatoes and carrots), can be crushed or grated, and the starch washed out, cleaned, and collected. Starch may be viewed *in situ* by cutting thin sections of potato. These may be dried by the ether process (vol. xix., p. 194), and some mounted dry, and others transferred to benzol, and then mounted in balsam.

* This is a very cleanly prepared *maize*-starch, which may be used for nearly every purpose where arrow-root is required. It would be well if manufacturers would call things by their right names. The term "flour" is likely to mislead; it means something quite different. Corn-starch or maize-starch would be more suitable.

* *Tous-les-mois* can be obtained of Messrs. Fortnum and Mason; also *genuine* arrow-root and other materials, which can be depended upon for use as standard samples.

Starches from various sources, and the structure of wheat, barley, and other kinds of grain, are accurately figured in "Hassall," pp. 242—256 and 314—321.

The student should make accurate outline sketches of all the starches examined, with the camera-lucida or tinted reflector, selecting, in each specimen, the largest and smallest granules, and also some of intermediate size. A scale should be drawn on the paper from the micrometer. The shape and dimensions of starch granules and other similar objects are readily compared from such drawings, and with far greater facility than from lists of micrometric figures.

Chalk.—Scrape a small portion of the chalk upon a slide. Place upon it a drop of water, stir it up, allow the larger particles to subside, and then gently tilt the slide, so that the water may run down, and carry with it the lighter particles. Absorb the surplus wet with blotting-paper, dry cautiously over the lamp-chimney, and mount in balsam.

Examine with O½, or [O1, E2 or 3] black-field illumination, with Parabola or [*spotted-lens*]. If the preparation has been successful, *Foraminiferæ* may be distinguished among some of the particles. It is well to make two or three preparations, in case of failure.

To obtain the shells, sponge-spicules, &c., separately, it will be necessary to break up the chalk. This is best effected by boiling in a solution of sulphate of soda, made strong enough to crystallize on cooling: on this taking place, the chalk will be found to be disintegrated (Quckett's "Lectures on Histology," vol. ii., p. 80). Sufficient water should then be added to dissolve the crystals, the mixture agitated, and the chalk allowed to settle. The fluid should be decanted, the vessel again filled up with water, and decantation repeated before the finer particles have subsided. By continuing this process, if carefully managed, the shells will be obtained, eventually, nearly or quite clean. The washings should be allowed to settle, and be examined with the microscope, to ascertain whether they contain any of the smaller fossils. The shells may be mounted dry or in balsam. The result will vary according to the locality from which the chalk was obtained.

Another very efficient process, by Mr. E. H. Robertson, will be found in *Science Gossip*, vol. iii., p. 36.

If the sponge-spicules and siliceous fossils only are required, they can be obtained by dissolving the chalk in dilute hydrochloric acid.

The coarse matter left after chalk has been washed for the purpose of making whiting is, when it can be procured, a good material to operate upon, as it is much richer in minute fossils, which are left in the heavier portions of the chalk.

The *Polycystinæ* may be obtained from the "Barbadoes-earth," by a process fully described by S. Furlong, *Quarterly Microscopical Journal*, Jan., 1861; also quoted by Davies, in "Mounting Microscopic Objects," p. 64.

Sugar and Salt.—The preliminary examination has already shown that these two substances differ materially in appearance from the others with which they were compared. While they exhibited none of the organised structure of the flour and starch, yet the difference between them and the chalk was very marked. They presented, when not too much crushed, traces of a certain regularity of form, which was entirely absent in the latter mineral. The condition of both the sugar and salt was very unfavourable for the study of these regular forms, which are known as crystalline. For further examination, it will be necessary to procure uninjured specimens.

Well-formed crystals may generally be found in most samples of good moist-sugar: a few of these are to be mounted in balsam, for examination. Sugar is rather difficult to crystallise in the small way, the general result being an amorphous film on the slide. For a very full account of sugar, see "Hassall," pp. 181—198.

Crystals of salt are easily obtained. Make a strong solution in distilled water, by boiling in a test-tube, and filter while hot. A drop of this fluid, placed upon a slide, will soon deposit a number of cubic crystals. These and the sugar-crystals may be viewed with a low power, O2, and dark-field illumination, by means of the Parabolic Reflector or [*spotted lens*]. This mode of lighting is very useful in such examinations, as it aids considerably in estimating solidity. Beyond regular mathematical form, no structure is to be observed in these bodies. *Polarised light*, however, renders certain optical peculiarities apparent.

Arrange the microscope for the use of the polariscope: it will then be seen that the crystals of salt are not at all affected by the altered illumination, and this is the case with all crystals belonging to the cubic system: crystals of potash-alum will supply another example. Let the sugar now be examined in the same way: it will be found, upon rotating the analyser or polariser, that they either become coloured or, when the field is darkened, remain luminous. If the thickness of the crystals is not adapted to produce colour, the use of a suitable selenite film will assist in obtaining it. It is here evident that polarised light reveals something which we should not be aware of without its aid: it supplies the means of determining whether a crystal possesses the property of double refraction or not.

The forms and colours of many crystals are extremely beautiful, and a collection is very easily made. As a long list will be found in "Carpenter," p. 773, only a few salts will be mentioned here.

Make a hot saturated solution of sulphate of copper. If a drop of this warm solution is placed upon a slip of glass, and examined at once,* long crystals, with sloping ends like a turner's chisel, will be seen shooting out from the edge, which will eventually cover the centre. If a small quantity of nitrous ether be added to the solution, a number of the crystals will be obtained in the form of separate rhomboids, which will shine like richly-coloured gems on the black field of the polarising microscope. Both slides, when dry, should be mounted in balsam, and labelled.

Some curious phenomena attending the crystallisation of sulphate of copper are described by Mr. R. Thomas in the *Quarterly Microscopical Journal* (1866, p. 177). An abstract of the paper, with figures, will be found in "Beale," p. 214.

The crystals of salicine are very easily made, and are very good examples of radiating crystals. A saturated solution in distilled water is to be made, and a drop, placed on a carefully-cleaned slide, is to be evaporated over the lamp until it dries into an amorphous mass. Upon cooling, a number of circular groups of crystals will generally be formed; this may be aided by breathing on the slide, the moisture often inducing the formation of the crystals. When sufficiently developed, the process should be stopped, by gently heating over the lamp-chimney, and mounting at once in balsam.

* For this purpose, the microscope must be placed vertically, to prevent the fluid running off the slide, as the observation is best made without a cover. The instrument should only be used in this position when absolutely necessary, as it is uncomfortable and inconvenient.

An account of the mode of making the beautiful flower-like crystals of sulphate of copper and magnesia is given in "Mounting Microscopical Objects," by T. Davies, p. 76.

Lesson IV.

Structure of Wood.

With the point of a sharp knife, split, *not cut*, thin splinters from a lucifer match or piece of deal. Suitable fragments may often be found at the bottom of a box of matches. Examine with O1; illuminate with Parabolic Lieberkuhn or [*condensing lens*], using Disc-Holder or [*stage forceps*] as a support. The splinter will exhibit a fibrous structure, varying in character according to the direction of the split. The simplest structure in this specimen is the cellular tissue crossing the woody fibres; these lines of cells run from the centre of the stem to the circumference, among the fibres and ducts, keeping up a communication between the centre and the growing portion between the wood and the bark, known as the *cambium layer*. The sides of the woody fibres are, in deal, covered with rows of dots, which are characteristic of the *Coniferæ*, although they are found in the woody tissues of some few other trees. To see these well, a higher power will be required, O½, and Parabolic, or [*spherical lieberkuhn*], and to secure the most favourable position for observation the disc-holder will be found convenient.

To thoroughly investigate the structure of wood, three sections are necessary, one across the stem and two in a longitudinal direction. For the purpose of study, where large and fine specimens are not required, the use of a section machine may be dispensed with, as small sections in any direction may easily be cut with a sharp knife or razor.

The transverse section shows the general arrangement of the tissues composing the stem, consisting of a concentric arrangement of fibres and vessels, of which the cut ends only are seen in this section; the concentric rings represent periods of growth, and usually, but not always, correspond with the number of years the stem has been forming; the *medullary* rays are seen running from the pith in the centre to the circumference—they are developed to an enormous extent in the Clematis, where their grouping in masses gives a marked character to the transverse section.

The other two sections are longitudinal, and are cut, one parallel to the medullary ray and the other across it. The first, or *radial section*, exhibits the sides of the medullary rays; the second, *tangential section*, their cut ends; these are very conspicuous in mahogany.

The structure of the stem of endogenous plants differs considerably from that of exogens, just described; in these, there is no very marked distinction between wood and bark—the rings of annual growth and the medullary rays are wanting, so that a single longitudinal section only is required, instead of the two needed to demonstrate the structure of an exogen (a section of cane will supply a good example). For the histology of plants, see Bentley's "Manual of Botany," Book I. There are many very accurate figures of vegetable tissues throughout Hassall. The knowledge of the minute structure of plants is of the greatest use to the analytical microscopist, as it is by this means alone that mixtures of vegetable powders can be detected. Full details are given in Hassall.

Sections of woods, such as ebony, box, and some others, which are too hard to be cut in the usual manner, may be obtained by grinding, as in the case of bone; this process must also be adopted with cellular tissue, when hardened by deposits of sclerogen, as cherry and plum stones, ivory nuts, cocoa-nut shell, and many other hard substances. Soft substances, as leaves, may be cut by being pressed between two pieces of cork, which are sliced with it. Cellular tissue like that of the common rush, which yields so much to the knife that it is pressed aside instead of being cut, should be saturated with melted wax before attempting to make a section; this can be removed from the thin slices with benzol.

(To be continued.)

GALVANOSCOPIC LANTERN.

BY EDWIN SMITH, M.A.

Having occasion to exhibit to an audience some of my recent experiments on the electrical phenomena of plants, I was obliged to invent some means of throwing the image of the index of a sensitive galvanometer upon a screen. I did not want to use the electric light, or to add the weight of even a small mirror to the astatic needles; otherwise a bright spot of light might have been made to indicate the deflections on the plan of a Thomson's galvanometer. After a good many trials of various expedients, I hit upon the following, which I found to answer my purpose admirably. It is an application of the principle of the magic lantern, and is at once simple and effective. It requires no stronger light than that afforded by a large belmontine lamp. The hands of the operator, not being wanted for troublesome adjustments of the illumination, are at liberty for the performance of his experiments. The apparatus is also inexpensive. No iron must, of course, enter into its structure; I made mine of wood, with brass screws, only adding a copper chimney to the box which contained the lamp. The light thus enclosed is placed in the focus of a large condensing lens. A circular aperture is left in the lamp-box of the same size as the lens for that purpose. The rays, being made parallel by the condenser, fall upon a mirror behind, sloped at an angle of 45°, and are thus thrown upwards past the moving index of the galvanometer. This index, formed of the lightest possible stem of grass, is fixed at right angles to the upper needle, and projects horizontally over the lower mirror before mentioned. Just above the index, and in the top of the box, are placed the front lenses of a magic lantern, which throw divergent rays upon a second mirror, also inclined at a suitable angle, by which they are finally cast upon the white screen. It is best to adjust the lower mirror first with regard to the light, then to adjust the sliding lenses, till a distinct black image of the index is obtained stretching across a bright field. The front and the back of this apparatus may be made movable to enable one to get at the interior when necessary. An upright narrow case of cardboard, strengthened by two parallel ends of wood, should be placed so as to contain the arrangements for suspending the needles, and prevent gusts of air from disturbing them. Two mercury cups may be drilled behind the box in the thick board which forms its bottom, and which should project beyond the sides for the purpose of carrying three or four levelling-screws. Every part of the box, inside and outside, must be stained black.

I can strongly recommend the above contrivance to the notice of teachers and lecturers. A popular audi-

ence seems to understand the clock-like movements of a black finger upon a screen more readily than the linear motions of a bright spot. The spectators feel as if they saw the needle itself which is being deflected by voltaic currents.

ON THE

ESTIMATION OF THREE KINDS OF SUGAR IN ONE SOLUTION.

BY A. DUPRE, PH.D.,

LECTURER ON CHEMISTRY AT WESTMINSTER HOSPITAL.

For some years past, I have been constantly in the habit of estimating two, and sometimes three, kinds of sugar present in one solution, by the conjoint use of the chemical and optical methods. The plan adopted by me differs from that of Professor Apjohn described in the Chemical News (vol. xxi., p. 86; *Am. Repr., May*, 1870, *page* 230), and, I believe, solves the same problem in a more direct manner. This problem is the estimation of cane, grape, and fruit sugar, when present in the same solution. Invert-sugar is a mixture, or compound, of fruit and grape sugar in equivalent proportions, and its amount can therefore readily be calculated if the amount of these two sugars be known.

Now, cane-sugar does not reduce the cupric solution, and is not affected by heating with a dilute solution of caustic alkali. Both grape and fruit sugar, however, reduce the cupric solution, and both are readily destroyed by being heated with a solution of caustic alkali. We can thus estimate the amount of cane-sugar, by its rotative power, having previously destroyed the grape and fruit sugar; we can estimate, chemically, the aggregate amount of these last two sugars, quite independently of the presence or absence of cane-sugar. We have now only to estimate the amount of rotation due to the three sugars jointly, and are then in possession of all the necessary data for the quantitative estimation of each.

It will be seen that the cane-sugar is estimated by direct observation; and the problem thus, in reality, resolves itself into the estimation of a mixture of grape and fruit sugar. The amount of rotation produced by these two being estimated directly, if cane-sugar be absent; indirectly, in the presence of cane sugar, by subtracting the rotation due to the cane-sugar from the rotation produced by the three sugars jointly.

The instrument employed by me (one of Professor Jellet's beautiful saccharometers) has a 10-inch tube, in which a solution containing—

1 per cent cane-sugar, required for compensation 0·2418 inches left-handed turpentine.

1 per cent fruit-sugar, required for compensation 1·502 inches of a 10 per cent cane-sugar solution.

1 per cent grape-sugar,* was equivalent to 0·836 inches of 10 per cent cane-sugar solution.

Now, let x be the amount of fruit-sugar sought; let y be the amount of grape-sugar sought; let p be the sum of both sugars found by the cupric solution expressed in percentages; and let a be the number of inches of 10 per cent cane-sugar solution which has been found to compensate, or be equivalent in rotating power to, the mixture p of fruit and grape sugar present.

* I have throughout taken grape-sugar dried at 100°, when its composition is $C_6H_{12}O_6$, the same as fruit-sugar.

We have then the equations—

$$x+y=p$$

$$x\times 1{\cdot}502-y\times 0{\cdot}836=\pm a$$

and

$$x=\frac{p\times 0{\cdot}836\pm a}{2{\cdot}338}$$

$$y=p-x$$

As regards a, the sign + is taken if the mixture of the two sugars turns to the left, and requires to be compensated by the cane-sugar solution; the sign −, if the mixture turns to the right; in which case a represents the number of inches of 10 per cent cane-sugar solution equal in rotative power to this mixture, as estimated by the left-handed turpentine, calculated, of course, in either case, for the 10-inch tube.

I have employed the foregoing method only for estimating the amounts of these three sugars present in wines, but it is, no doubt, equally applicable to crude sugars and syrups.

THE WATER-TYPE.

BY J. ALFRED WANKLYN.

The following propositions are, I believe, admitted generally at the present time:—

(1). That the oxy-salts of the metals are built on the water-type, and consist of acid-forming radical and metal, bound together by one or more atoms of oxygen.

(2). That an acid is a salt wherein hydrogen plays the part of the metal, being bound by means of oxygen to an acid-forming radical; and that, in like manner, an alkali is a structure wherein hydrogen is bound by oxygen to a metal.

(3). That double decompositions between salts, or between salts and acids or alkalies, or between acids and alkalies, consist in exchanges of one metal for another metal, or for hydrogen. Thus the double decomposition between sulphate of potash and nitrate of baryta is commonly regarded as consisting in an exchange of potassium for barium, whereby sulphate of baryta and nitrate of potash are produced. The same result may be conceived as being produced by the exchange of sulphuryl for nitroxyl $(NO_2)_2$; but chemists do not usually refer these double decompositions to displacements of the acid-forming radicals. The nomenclature which is in use favours the one mode of representation and discourages the other. Thus, keeping to the example above given, chemists of the present day write sulphate of potassium, or potassic sulphate or potassium sulphate and nitrate of barium, baric nitrate or barium nitrate; names which suggest the view that double decomposition takes place by exchange of the metals. The terms potassate of sulphuryl and bariumate of nitroxyl (names which would point to exchange of acid-forming radicals as the *modus operandi* of double decomposition) have, so far as I know, never been proposed by any one.

As may be gathered from his recent papers, the author of the present notice is prepared to offer other modes of representation, in place of those which have just been set forth, and which are in vogue at the present time.

Instead of looking upon the oxy-salts of the metals as consisting of acid-forming radical and metal held together by oxygen, it is proposed to consider them as

being structures wherein oxygen and acid-forming radical are held together by the metal. Thus, quoting from a former paper, acetate of soda is regarded as the following:—

$$Na''' \left\{ \begin{matrix} O'' \\ (C_2H_3O)' \end{matrix} \right.$$

And it should be understood that the considerations which have been urged for the metal sodium and its compounds are taken as being of extensive application, and, with slight modifications, as applicable to the metals in general.

The analogy between acids and metallic salts the author of this notice denies. That the acids are built on the water-type he is, indeed, not prepared to deny; but he maintains that the acids and the metallic salts are built on totally different types. The alkalies, instead of being waters and being like the acids in structure, are like metallic salts. Thus caustic soda is—

$$Na''' \left\{ \begin{matrix} O'' \\ H \end{matrix} \right.$$

Double decompositions between metallic salts, or between salts and acids or alkalies, or between acids and alkalies, are exchanges of one acid-forming radical for another, or for hydrogen. Such, then, is the contrast between that which is generally received by chemists and that which is proposed as a substitute for it.

These opposite modes of representation are, as a little reflection will show, embodiments of fundamental notions respecting the analogy, or want of analogy, between hydrogen and metals.

The one which is generally in vogue expresses resemblance between hydrogen and metals.

The other, which is proposed, expresses dissimilarity between hydrogen and metals.

Is there, then, as a matter of fact, fundamental analogy, or fundamental want of analogy between hydrogen and metals?

In endeavouring to arrive at a just conclusion on this point, it will hardly be proper to omit mentioning the very obvious facts of the extreme physical dissimilarity of hydrogen to the metals. Whilst hydrogen is the lightest known gas (not liquefied by any degree of cold or of pressure hitherto applied to it), there are metals which figure as the heaviest known solids, and there are metals which have hardly been fused; and all, save one, are solids, under ordinary conditions. There is, moreover, a total want of continuity of physical properties between hydrogen and metals. In volatility, the metal next to hydrogen is mercury; but there is an immense gap between a substance which has not been liquefied and a substance which, like mercury, only ceases to be liquid at 360° C.

The extreme eagerness with which chemists seize upon the faintest shadow as a pretext for assigning to hydrogen the faculty of existing in a condensed state is, to my mind, evidence of the great importance instinctively allowed to the vast physical dissimilarity between hydrogen and metals which are next of kin to hydrogen, according to popular chemical belief.

The facts of the vapour-densities of hydrogen-compounds, and of such metallic compounds as have been investigated in this direction, reiterate the same tale of dissimilarity.

In the standard two volumes of hydrochloric acid gas, there exists only one volume of chlorine; but, in the standard two volumes of chloride of mercury vapour, or chloride of aluminium, or chloride of iron, there are more than one volume of chlorine. The vapour-densities of organo-metallic bodies, moreover, all exhibit more than one volume of organic radical in the standard two volumes of vapour. Up to the present time, no metallic compound has been found to exhibit a vapour-density which should entitle it to figure as a representative of hydrochloric acid gas.

These facts have already exercised a part of their legitimate sway over the theories of metallic structures admitted by the generality of chemists. The old *exact* parallels between salts of hydrogen and salts of metals is no longer maintained in its integrity. Between the formulæ for acetic acid and acetate of zinc we no longer see the ancient all-but-identity.

They used to be*—

$$\begin{matrix} C_2H_3O \\ H \end{matrix} \Big\} O \qquad \begin{matrix} C_2H_3O \\ Zn \end{matrix} \Big\} O$$

They are to-day—

$$\begin{matrix} C_2H_3O \\ H \end{matrix} \Big\{ O \qquad \begin{matrix} (C_2H_3O)_2 \\ Zn'' \end{matrix} \Big\} O_2$$

And, in making proposals for sweeping changes in the notation of metallic compounds, I have not to confront a simple and uniform body of notation, but, on the contrary, the confused and, in many respects, arbitrarily-complex formulæ which are strewed through that deluge of modern text-books of chemistry which has flooded the scientific press.

A comparison of the chemical characters of hydrogen compounds with those of metallic compounds will next be instituted.

One of the chief arguments in support of analogy between hydrogen and metals may be stated as follows:—

For every acid (which is a salt of hydrogen), there exists a whole series of metallic derivatives (salts of the metals); and the properties of salts present a graduated series, in which series the properties of the hydrogen term (or acid) constitute a sort of natural first-term.

In criticism, it may be urged that, although there cannot be an acid and no corresponding salts (for the definitional reason that we require salts in order to recognise the claim to be regarded as an acid), still the converse does not hold good. We do know salts the acids corresponding to which are non-existent, or, at any rate, have hitherto resisted all attempts to prepare them. Moreover, the case of exceeding stability in the metallic salts, and exceeding fragility in the acid, is of frequent occurrence. One of the most familiar maxims in the practical management of chemical operations is that there is a world of difference between that kind of chemical action which takes place in neutral or alkaline solutions and that which happens in presence of free acid. Solution of chromic acid is an oxidising agent of great potency. Solutions of chromates of the metals are almost destitute of oxidising power. These differences between the properties of the acid and the properties of its salts lead on to the discussion of the question of the series of salts with the so-called salt of hydrogen for its initial term.

The sulphates, for example. Water typists tell us that sulphate of potash is inert, because potassium is so strongly electro-positive as to balance the strongly electro-negative sulphuryl which is bound to it by the in-

* Ten years ago, in commenting on the vapour-densities of metallic compounds, I employed the phrase—Zinc and mercury, regarded as to the densities of their compounds, are to be looked upon as representatives, not of hydrogen, but of oxygen. My own views respecting the structure of zinc compounds have, it is true, undergone development since that time, but still, the train of thought which dictated the phrase is in accordance with my present convictions on the subject.

tervention of oxygen. Sulphuric acid is energetic, because hydrogen is not sufficiently electro-positive to counterpoise the sulphuryl.

But the water typists fail to explain how it comes to pass that sulphate of silver is not energetic; for, since silver is unquestionably less electro-positive than hydrogen, the silver-salt should be even less balanced than the hydrogen-salt.

Bearing in mind that the electro-chemical place of hydrogen is, in reality, an intermediate one, hydrogen being more electro-positive than some metals, and less so than others, it is difficult to see on what principle the so-called salt of hydrogen can be made to occupy the first place in the saline series. Obviously, it would not do to range in series according to volatility. (Mercury comes next to hydrogen in volatility, and yet mercury-salts are not particularly like acids). Neither could an arrangement according to magnitude of atomic weight be attempted; for the properties of salts are obviously not related to the atomic weights of the metals.

In short, though there are gradations of properties among the metallic salts, these gradations are broken in arriving at the so-called salts of hydrogen; and, in addition to those broad and obvious distinctions between acids and salts which have arrested the attention of chemists ever since chemistry began to be cultivated, there is a fundamental dissimilarity that is at least as broad as that which lies on the surface of the subject.

Recurring to the statement of the water typists that, for every acid, there exists a whole series of metallic derivatives, I have to remark that this should be carefully distinguished from another statement, viz.:—"For every atom of hydroxyl in a compound, an equivalent of *metaloxyl* may be substituted." This latter statement is especially far removed from the truth. By far the greater part of the hydroxyl, the existence of which is recognised by chemists, is incapable of undergoing even pseudo-replacement by most kinds of metaloxyl. I need hardly refer particularly to the now well-known distinction in organic chemistry between such hydroxyl the hydrogen of which is recognised as being easily replaceable by metals, and such as does not admit of such replacement.

It will not be necessary to do more than allude to the fact that the vast array of compounds of carbon with hydrogen is unrepresented by corresponding compounds of carbon with metals. When zinc was made to unite with ethyl, there did not result a representative of ethyl-hydride, but a representative of ethyl-oxide, which is double. When sodium was made to combine with ethyl, it dragged along with it zinc in union with ethyl, and furnished a representative, not of ethyl-hydride, but of ammonia.

From the foregoing, it appears that there is the utmost fundamental dissimilarity between hydrogen and metals. On a future occasion, I propose to develop the new notation of metallic compounds.

London, Feb. 21st, 1870.

A NEW THEORY OF THE CONSTITUTION OF METALLIC COMPOUNDS.

BY J. ALFRED WANKLYN.

In most recent manuals of chemistry, whilst nitrate of potash is written KNO_3, nitrate of baryta is written $Ba''N_2O_6$; nitrate of zinc, $Zn''N_2O_6$, &c. In short, whilst the salts of the alkalies and of silver figure as if they were like salts of ethyl, the salts of barium, calcium, magnesium, mercury, zinc, &c., are made to resemble, in formula, the salts of ethylene. Such being the case, it might be expected that the characteristics of distinguishing alcohol compounds from glycol compounds should be presented by the two classes of metallic salts—for instance, the property of forming a fully-saturated and a half-saturated salt might be looked for in barium compounds. We know, however, of no half-nitrate or half-acetate of baryta; and, speaking generally, although the adoption of the two orders of formula for the two classes of metals is an assertion that monobasic acids form only one salt with an alkali-metal or with silver, and two salts with every such metal as barium, yet chemists do not know that such is the case (as a matter of experiment).

That the present glycol-formulæ for the compounds of barium, calcium, magnesium, &c., should have come into general use, and that there should be next to no experimental support for these formulæ, is a most extraordinary thing, and speaks volumes for the depressed state of our chemical conservatives.

The reasons for the adoption of glycol formulæ in the instance of certain metals were partly some very doubtful deductions drawn from the specific heat of the metals, and mainly considerations of the vapour-density of certain metallic compounds.

The facts ascertained concerning the vapour-densities of metallic substances are as follows:—

If the atomic weight of mercury be calculated from the vapour-density of metallic mercury, we arrive at the number 100 for the atomic weight of the metal. In like manner, calculating from the vapour-density of metallic zinc, we get 32·5 for the atomic weight of the metal. But, if, instead of operating upon the metal, we take the chloride or the eythl-compound, and deduce the atomic weights from the vapour-densities of those compounds, we get 200 for mercury and 65 for zinc. In presence of this discrepancy, chemists have elected to receive the values obtained from the chlorides or eythl-compounds, and to reject those from the free metals. This procedure involves rather startling theoretical consequences. Chemists maintain that oxygen, hydrogen, nitrogen, chlorine, bromine, and iodine, when existing in the free state, exist in the form of molecules, each molecule being formed of two atoms. Chemists maintain, also, that free sulphur, or free phosphorus, or free arsenic exists in the state of molecules, whereof each molecule contains more than two atoms of the element; and, along with all this, chemists maintain that metallic mercury or zinc consists of molecules, whereof each molecule contains only *one* atom of the element. If so vital a distinction existed between the constitution of a free metal and a free metalloid, we ought to find a stupendous difference in chemical or physical properties accompanying these differences in structure. There is, however, nothing very special about metallic mercury or metallic zinc—nothing that should lead to the adoption of extraordinary formulæ for them.

In the new system of notation which I propose, I take the molecule of zinc and of mercury as consisting of two atoms, just as in the case of oxygen, hydrogen, nitrogen, or chlorine; and I take the great density of the vapours of chloride of mercury and zinc-ethyl as proving that these compounds belong to the second rank of mercurial or zinc compounds. The new nota-

tion, as a consequence of this mode of treatment, does not require that potash, barium, and zinc salts should be written on radically different types, but restores to the chemistry of the metals much of the simplicity which has been so recently lost.

In two papers published in the Chemical News (vol. xx., pp. 293, 313; *Am. Repr., Feb.* 1870, pages 80, 81), I gave the new formulæ for the compounds of sodium. I now give the new formulæ for the compounds of zinc—

$Zn''' = 32{\cdot}5$

Free zinc.....$Zn'''.Zn'''$

Oxide of zinc.....$Zn''' \left\{ \begin{matrix} O \\ — \\ — \end{matrix} \right\} Zn'''$

Hydrated oxide of zinc .....$Zn''' \left\{ \begin{matrix} O'' \\ H \end{matrix} \right.$

Nitrate of zinc.....$Zn''' \left\{ \begin{matrix} O'' \\ NO_2 \end{matrix} \right.$

Acetate of zinc.....$Zn''' \left\{ \begin{matrix} O'' \\ (C_2H_3O)' \end{matrix} \right.$

Sulphate of zinc.....$Zn''' \left\{ \begin{matrix} O'' & O'' \\ -SO_2- \end{matrix} \right\} Zn'''$

Chloride of zinc.....$Zn''' \left\{ \begin{matrix} Cl\ Cl \\ — \\ — \end{matrix} \right\} Zn'''$

Zinc-ethyl.....$Zn''' \left\{ \begin{matrix} C_2H_5\ C_2H_5 \\ — \\ — \end{matrix} \right\} Zn'''$

Hydrochlorate of zinc.....$Zn''' \left\{ \begin{matrix} OH \\ Cl \\ H \end{matrix} \right.$

The double compound of zinc-ethyl and sodium-ethyl I write—

$$Na''' \left\{ \begin{matrix} (Zn_2)''C_2H_5 \\ C_2H_5 \\ C_2H_5 \end{matrix} \right.$$

From the foregoing, and from these examples, and from those given in my two papers which appeared in the Chemical News (vol. xx., pp. 293, 313; *Am. Repr., Feb.* 1870, pages 80, 81), it will be perceived that I propose to write the compounds of the so-called "diatomic metals" in the same way as the compounds of the so-called monatomic metals, and that, in fact, I deny that any metal is diatomic. Into the same great class I put potassium, sodium, lithium, cæsium, rubidium, thallium, barium, strontium, calcium, magnesium, zinc, cadmium, mercury, manganese, bismuth, antimony, arsenic, phosphorus, nitrogen, and some others. This is the 3, 5, 7 atomic class.

Into class 2 is put tin, iron, aluminium, chromium, and some others. Class 2 is 4-atomic.

All the metals fall into one or other of these two classes.

Some of the principles embodied in the new mode of notation are:—

That the metals are fundamentally unlike hydrogen, and that they are eminently polyatomic.

That, most commonly, the metallic chlorides and ethyl-compounds are more complicated in structure than very many other compounds of the metal.

That the hydrated chloride is usually a definite compound.

That double decompositions take place by exchange of the acid-forming radicals of two salts.

On a future occasion, I propose to give examples of the new notation.

London, February 26th, 1870.

ON THE

CONTINUITY OF THE GASEOUS AND LIQUID STATES OF MATTER.*

BY THOMAS ANDREWS, M.D., F.R.S.,

VICE-PRESIDENT OF QUEEN'S COLLEGE, BELFAST.

In 1822 M. Cagniard de la Tour observed that certain liquids, such as ether, alcohol, and water, when heated in hermetically sealed glass tubes, became apparently reduced to vapour in a space from twice to four times the original volume of the liquid. He also made a few numerical determinations of the pressures exerted in these experiments. In the following year Faraday succeeded in liquefying, by the aid of pressure alone, chlorine and several other bodies known before only in the gaseous form. A few years later Thilorier obtained solid carbonic acid, and observed that the coefficient of expansion of the liquid for heat is greater than that of any aëriform body. A second memoir by Faraday, published in 1826, greatly extended our knowledge of the effects of cold and pressure on gases. Regnault has examined with care the absolute change of volume in a few gases when exposed to a pressure of twenty atmospheres, and Pouillet has made some observations on the same subject. The experiments of Natterer have carried this inquiry to the enormous pressure of 2790 atmospheres; and although his method is not altogether free from objection, the results he obtained are valuable and deserve more attention than they have hitherto received.

In 1861 a brief notice appeared of some of my early experiments in this direction. Oxygen, hydrogen, nitrogen, carbonic acid, and nitric oxide were submitted to greater pressures than had previously been attained in glass tubes, and while under these pressures they were exposed to the cold of the carbonic acid and ether-bath. None of the gases exhibited any appearance of liquefaction, although reduced to less than 1-500th of their ordinary volume by the combined action of cold and pressure. In the third edition of Miller's "Chemical Physics," published in 1863, a short account, derived from a private letter addressed by me to Dr. Miller, appeared of some new results I had obtained, under certain fixed conditions of pressure and temperature, with carbonic acid. As these results constitute the foundation of the present investigation and have never been published in a separate form, I may, perhaps, be permitted to make the following extract from my original communication to Dr. Miller. "On partially liquefying carbonic acid by pressure alone, and gradually raising at the same time the temperature to 88° F., the surface of demarcation between the liquid and gas became fainter, lost its curvature, and at last disappeared. The space was then occupied by a homogeneous fluid, which exhibited, when the pressure was suddenly diminished or the temperature slightly lowered, a peculiar appearance of moving or flickering striæ throughout its entire mass. At temperatures above 88° no apparent liquefaction of carbonic acid, or separation into two distinct forms of matter, could be effected, even when a pressure of 300 or 400 atmospheres was applied. Nitrous oxide gave analogous results."†

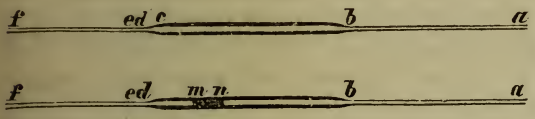
In the following experiments the gas to be compres-

* The Bakerian Lecture for 1869, delivered before the Royal Society. Communicated to the Chemical News, and revised by the author.

† Miller's "Chemical Physics," 3rd edition, p. 328.

sed is introduced into a tube, *f*, *a* (Fig. 1), having a capillary bore from *a* to *b*, a diameter of about 2·5 m. m. from *b* to *c*, and of 1·25 m.m. from *c* to *f*. The gas carefully dried is passed for several hours through the tube open at both ends, as represented below. The presence of a column of water of two metres in height

Fig. 1.



was necessary to maintain a moderate stream of gas through the fine capillary tube. In the case of carbonic acid, the gas, after passing through the apparatus, was made to bubble by means of a connecting tube through mercury, and a portion was collected from time to time, in order to ascertain its purity. The current was continued till the residual air, after the action of caustic potash, was reduced to a constant minimum. In repeated trials I found that in the complicated arrangements I had to adopt, the residual air could not be reduced to less than from 1-500th to 1-1000th of the entire volume of the carbonic acid. Even after continuing the current for twenty-four hours this residue appeared; and in discussing some of the results obtained by exposing the gas to high pressures, the presence of this small quantity of air must be carefully taken into account. The capillary end at *a* was then sealed, and the other end was also closed, and afterwards introduced under a surface of pure mercury contained in a glass capsule. The lower end, while under the surface of the mercury, was opened, and heat applied so as to expel a little of the gas. On cooling, contraction occurred, and a short column of mercury entered. The capsule and lower end of the tube were then placed under the receiver of an air-pump, and a partial vacuum was formed till about one-fourth of the gas was removed. On restoring the pressure, a column of mercury entered and occupied the place of the expelled gas. By withdrawing the end of the tube from below the surface of the mercury in the capsule, and again exhausting cautiously, the column of mercury should be reduced to any required length. The tube, when thus filled, had the form shown in Fig. 1.

Two file-marks had been made, one at *d*, the other at *e*, in the narrow part of the tube, about 10 m.m. distant from each other, and the capacity of the tube from a mark near *a* to *d*, and also from the same mark to *e*, had been determined by filling it with mercury at a known temperature and weighing the mercury. The tube was now placed accurately in a horizontal position and connected by an air-tight junction with one limb of a long U-tube filled with mercury. Each limb of the U-tube was 600 m.m. long, and 11 m.m. in diameter. By removing mercury from the outer limb of the U-tube, a partial vacuum was obtained, and the column of mercury, *m*, *n*, was drawn into the narrow tube, *d*, *f*. From the difference of capacity of this part of the tube, the column of mercury was now about four times longer than before. It was easy with a little care so to adjust the pressure that the inner end of the mercurial column coincided with the mark *e*. When this was accomplished, the difference of level of the mercury in the two limbs of the U-tube was accurately read by means of a cathetometer, and the height of the barometer as well as the temperature were carefully noted. Similar observations were made with the gas expanded to the mark *d*. Two independent sets of data were thus obtained for calculating the volume of the gas at 0° C. and 760 m.m., and the results usually agreed to less than 1-1000 part. The tube, after being disconnected with the U-tube, was cut across a little beyond *e*, and was now ready to be introduced into the pressure apparatus.

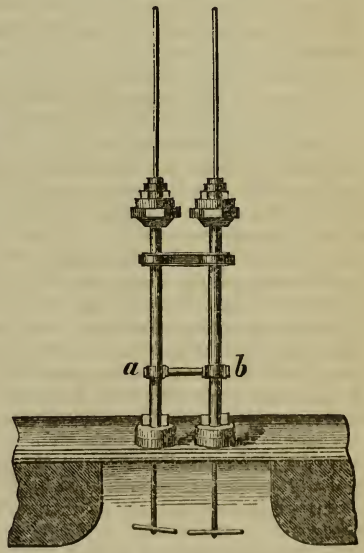
The capillary tubes were calibrated with great care, and their mean capacity was determined by weighing a column of mercury whose length and position in the tube were accurately observed. One m.m. of the air-tube used in these experiments had an average capacity of 0·00002477 c.c., and 1 m.m. of the carbonic-acid tube of 0·00003376 c.c. A table was constructed showing the corrected capacity of each capillary tube from the sealed end for every m.m. of its length. An allowance of 0·5 m.m. was made for the cone formed in sealing the tube.

For the sake of clearness I have described these operations as if they were performed in the detached tube. In actual practice, the tube was in the brass end-piece before it was filled with gas.

The construction of the apparatus employed in these experiments will be readily understood from Fig. 2,

Fig. 2.

Fig. 3.



which exhibits a section of the simple form. Two massive brass flanges are firmly attached round the ends of a cold-drawn copper tube of great strength, and by means of these flanges two brass end-pieces can be securely bolted to the ends of the copper tube, and the connections made air-tight by the insertion of leather washers. The lower end-piece carries a steel screw, 180 m.m. long, 4 m.m. in diameter, and with an interval of 0·5 m.m. between each thread. The screw

is packed with care, and readily holds a pressure of 400 atmospheres or more. A similar end-piece attached to the upper flange carries the glass tube containing the gas to be compressed. The apparatus, before being screwed up, is filled with water, and the pressure is obtained by screwing the steel screw into the water.

In the compound apparatus (Fig. 3) the internal arrangements are the same as in the simple form. A communication is established between the two sides of the apparatus through *a*, *b*. It is indifferent which of the steel screws below is turned, as the pressure is immediately diffused through the interior of both copper tubes, and is applied through the movable columns of mercury to the two gases to be compressed. Two screws are employed for the purpose of giving a greater command of pressure. In the figure the apparatus is represented without any accessories; when in use it is provided with arrangements for maintaining the capillary tubes and body of the apparatus itself at fixed temperatures. A rectangular brass case, closed before and behind with plate glass, surrounds each capillary tube, and allows it to be maintained at any required temperature by the flow of a stream of water. The body of the apparatus itself is enclosed in an external vessel of copper, which is filled with water at the temperature of the apartment. This latter arrangement is essential when accurate observations are made.*

The temperature of the water surrounding the air tube was made to coincide, as closely as possible, with that of the apartment, while the temperature of the water surrounding the carbonic acid tube varied in different experiments from 13° C. to 48° C. In the experiments to be described in this communication, the mercury did not come into view in the capillary part of the air-tube till the pressure amounted to about forty atmospheres. The volumes of the air and of the carbonic acid were carefully read by a cathetometer, and the results could be relied on with certainty to less than 0·05 m.m. The temperature of the water around the carbonic-acid tube was ascertained by a thermometer carefully graduated by myself according to an arbitrary scale. This thermometer was one of a set of four, which I constructed some years ago, and which all agreed so closely in their indications, that the differences were found to be altogether insignificant when their readings were reduced to degrees.

The general form of the curves representing the changes of volume in carbonic acid will hardly undergo any sensible change from the irregularities in the air-tube; nor will any of the general conclusions at which I have arrived be affected by them. It must, however, always be understood that when the pressures are occasionally spoken of as indicated by the apparent contraction of the air in the air-gauge, the approximate pressures only are meant.

To obtain the capacity in cubic centimetres from the weight in grammes of the mercury which filled any part of a glass tube, the following formula was used,

$$C = W.\frac{1+0{\cdot}000154.t}{13{\cdot}596}.1{\cdot}00012,$$

where C is the capacity in c.c., W the weight of the mercury which filled the tube at the temperature *t*, 0·000154 the coefficient of apparent expansion of mercury in glass, 13·596 the density of mercury at 0°, and 1·00012 the density of water at 4°.

* In the original memoir a figure is given representing the apparatus with all these accessories.

The volume of the gas V, at 0° and 760 m.m. of pressure, was deduced from the double observations, as follows.

$$V = C.\frac{1}{1+a\,t}.\frac{h-d}{760}$$

where C is the capacity of the tube (Fig. 1) from *a* to *d*, or from *a* to *e*, *t* the temperature, *a* the coefficient of expansion of the gas for heat (0·00366 in the case of air, 0·0037 in that of carbonic acid), *h* the height of the barometer reduced to 0° and to the latitude of 45°, *d* the difference of the mercurial columns in the U-tube, similarly reduced.

Having thus ascertained the volumes of the air and of the carbonic acid before compression, at 0° and 760 m.m., it was easy to calculate their volumes under the same pressure of 760 m.m., at the temperatures at which the measurements were made when the gases were compressed, and thence to deduce the values of the fractions representing the diminution of volume. But the fractions thus obtained would not give results directly comparable for air and carbonic acid. Although the capillary glass tubes in the apparatus communicated with the same reservoir, the pressure on the contained gases was not quite equal, in consequence of the mercurial columns, which confined the air and carbonic acid, being of different heights. The column always stood higher in the carbonic-acid tube than in the air tube, so that the pressure in the latter was a little greater than in the former. The difference in the lengths of the mercurial columns rarely exceeded 200 m.m., or about one-fourth of an atmosphere. This correction was always applied, as was also a trifling correction of 7 m.m. for a difference of capillary depression in the two tubes.

In order to show more clearly the methods of reduction, I will give the details of one experiment.

Volume of air at 0° and 760 m.m. calculated from the observations when the air was expanded to *a e*, 0·3124 c.c.

Volume of same air calculated from the observations when the air was expanded to *a d*, 0·3122 c.c.

Mean volume of air at 0° and 760 m.m., 0·3123 c.c.

The volumes of the carbonic acid, deduced in like manner from two independent observations, were 0·3096 c.c. and 0·3094 c.c. Mean, 0·3095 c.c.

The length of the column of air, after compression at 10·76° in the capillary air-tube, was 272·9 m.m., corresponding to 0·006757 c.c. Hence we have—

$$\delta' = \frac{0{\cdot}006757}{0{\cdot}3123 \times 1{\cdot}0394} = \frac{1}{48{\cdot}04}$$

But, as the difference in the heights of the mercurial columns in the air-tube and carbonic acid tube after allowing for the difference of capillary depression was 178 m.m., this result requires a further correction—$\frac{178}{760}$ of an atmosphere—in order to render it comparable with the compression in the carbonic acid tube. The final value for δ (the fraction representing the ratio of the volume of the compressed air at the temperature of the experiment to its volume at the same temperature and under the pressure of one atmosphere) will be—

$$\delta = \frac{1}{47{\cdot}81}$$

The corresponding length of the carbonic acid at 13·22°, in its capillary tube, was 124·6 m.m., equiva-

lent to 0·004211 c.c. from which we deduce for the corresponding fraction for the carbonic acid—

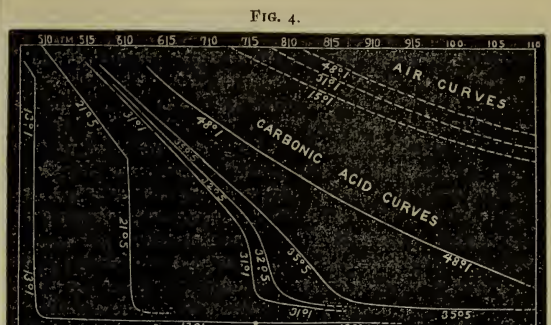
$$\epsilon = \frac{0{\cdot}004211}{0{\cdot}3095 \times 1{\cdot}0489} = \frac{1}{77{\cdot}09}$$

Hence, it follows that the same pressure which reduced a given volume of air at 10·76° to $\frac{1}{47{\cdot}81}$ of its volume, at the same temperature, under one atmosphere, reduced carbonic acid at 13·22° to $\frac{1}{77{\cdot}09}$ of its volume, at the temperature of 13·22°, and under a pressure of one atmosphere. Or, assuming the compression of the air to be approximately a measure of the pressure, we may state that, under a pressure of about 47·8 atmospheres, carbonic acid, at 13·22°, contracts to $\frac{1}{77{\cdot}09}$ of its volume under one atmosphere.

At the pressure of 48·89 atmospheres, as measured by the contraction of the air in the air-tube, liquefaction began. This point could not be fixed by direct observation, inasmuch as the smallest visible quantity of liquid represented a column of gas at least 2 or 3 m.m. in length. It was, however, determined indirectly by observing the volume of the gas 0·2° or 0·3° above the point of liquefaction, and calculating the contraction the gas would sustain in cooling down to the temperature at which liquefaction began. A slight increase of pressure was required even in the early stages to carry on the process. Thus the air-guage, after all reductions were made, indicated an increase of pressure of about one-fourth of an atmosphere (from 48·49 to 49·15 atmospheres) during the condensation of the first and second thirds of the carbonic acid. According to theory, no change of volume ought to have occurred. This apparent anomaly is explained by the presence of the trace of air (about 1-500th part) in the carbonic acid to which I before referred. It is easy to see that the increase of pressure shown in these experiments is explained by the presence of this small quantity of air. If a given volume of carbonic acid contain 1-500th of air, that air will be diffused through a space 500 times greater than if the same quantity of air were in a separate state. Compress the mixture till 50 atmospheres of pressure have been applied, and the air will now occupy, or be diffused through, ten times the space it would occupy if alone and under the pressure of one atmosphere; or it will be diffused through the space it would occupy if alone and under the pressure of 1-10th of an atmosphere. While the carbonic acid is liquefying, pressure must be applied in order to condense this air; and to reduce it to one-half its volume, an increase of 1-10th of an atmosphere is required. The actual results obtained by experiment approximate to this calculation. From similar considerations, it follows that if a mixture of air and carbonic acid be taken, for example in equal volumes, the pressure, after liquefaction has begun, must be augmented by several atmospheres, in order to liquefy the whole of the carbonic acid. Direct experiments have shown this conclusion to be true.

The small quantity of air in the carbonic acid disturbed the liquefaction in a marked manner, when nearly the whole of the carbonic acid was liquefied, and when its volume relatively to that of the uncondensed carbonic acid was considerable. It resisted for some time absorption by the liquid, but on raising the pressure to 50·4 atmospheres it was entirely absorbed. If the carbonic acid had been absolutely pure, the part of the curve for 13·1° representing the fall from the gaseous to the liquid state, would doubtless have been straight throughout its entire course, and parallel to the lines of equal pressure.

Fig. 4.



The curve representing the results at 21·5° agrees in general form with that for 13·1°, as shown in the above figure. At 13·1°, under a pressure of about 49 atmospheres, the volume of carbonic acid is little more than three-fifths of that which a perfect gas would occupy under the same conditions. After liquefaction, carbonic acid yields to pressure much more than ordinary liquids; and the compressibility appears to diminish as the pressure increases. The high rate of expansion by heat of liquid carbonic acid, first noticed by Thilorier, is fully confirmed by this investigation.

The next series of experiments was made at the temperature of 31·1°, or 0·2° above the point at which, by compression alone, carbonic acid is capable of assuming visibly the liquid form. Since I first announced this fact in 1863, I have made careful experiments to fix precisely the temperature of this critical point in the case of carbonic acid. It was found in three trials to be 30·92° C., or 87·7° F. Although for a few degrees above this temperature a rapid fall takes place from increase of pressure, when the gas is reduced to the volume at which it might be expected to liquefy, no separation of the carbonic acid into two distinct conditions of matter occurs, so far as any indication of such a separation is afforded by the action of light. By varying the pressure or temperature, but always keeping above 30·92°, the great changes of density which occur about this point produce the flickering movements I formerly described, resembling in an exaggerated form the appearances exhibited during the mixture of liquids of different densities, or when columns of heated air ascend through colder strata. It is easy so to adjust the pressure that one-half of the tube shall be filled with uncondensed gas and one-half with the condensed liquid. Below the critical temperature this distinction is easily seen to have taken place, from the visible surface of demarcation between the liquid and gas, and from the shifting at the same surface of the image of any perpendicular line placed behind the tube. But above 30·92° no such appearances are seen, and the most careful examination fails to discover any heterogeneity in the carbonic acid, as it exists in the tube.

The graphical representation of these experiments, as shown in Fig. 4, exhibits some marked differences from the curves for lower temperatures. The dotted lines in the figure represent a portion of the curves of a perfect gas (assumed to have the same volume at 0° and under one atmosphere as the carbonic acid) for the tem-

[English Edition, Vol. XXI., No. 536, page 103; No. 537, pages 111, 112.]

peratures of 13·1°, 31·1°, and 48·1°. The volume of the carbonic acid at 31·1°, it will be observed, diminishes with tolerable regularity, but much faster than according to the law of Mariotte, till a pressure of about 73 atmospheres is attained. The diminution of volume then goes on very rapidly, a reduction to nearly one-half taking place, when the pressure is increased from 73 to 75 atmospheres, or only by 1-37th of the whole pressure. The fall is not, however, abrupt as in the case of the formation of the liquid at lower temperatures, but a steady increase of pressure is required to carry it through. During this fall, as has already been stated, there is no indication at any stage of the process of two conditions of matter being present in the tube. Beyond 77 atmospheres carbonic acid at 31·1° yielded much less than before to pressure, its volume having become reduced nearly to that which it ought to occupy as a liquid at the temperature at which the observations were made.

The curve for 32·5° (Fig. 4) resembles closely that for 31·1°. The fall is, however, less abrupt than at the latter temperature. The range of pressure in the experiments at 35·5° extends from 57 to above 107 atmospheres. The fall is here greatly diminished, and it has nearly lost its abrupt character. It is most considerable from 76 to 87 atmospheres, where an increase of one-seventh in the pressure produces a reduction of volume to one-half. At 107 atmospheres the volume of the carbonic acid has come almost in conformity with that which it should occupy, if it were derived directly from liquid carbonic acid, according to the law of the expansion of that body for heat.

The curve for 48·1° is very interesting. The fall shown in the curves for lower temperatures has almost, if not altogether, disappeared, and the curve itself approximates to that which would represent the change of volume in a perfect gas. At the same time the contraction is much greater than it would have been if the law of Mariotte had held good at this temperature. Under a pressure of 109 atmospheres, the carbonic acid is rapidly approaching to the volume it would occupy if derived from the expansion of the liquid; and if the experiment had not been interrupted by the bursting of one of the tubes, it would doubtless have fallen into position at a pressure of 120 or 130 atmospheres.

I have not made any measurements at higher temperatures than 48·1°; but it is clear that, as the temperature rises, the curve would continue to approach to that representing the change of volume of a perfect gas.

I have frequently exposed carbonic acid, without making precise measurements, to much higher pressures and have made it pass, without break or interruption, from what is regarded by every one as the gaseous state, to what is, in like manner, universally regarded as the liquid state. Take, for example, a given volume of carbonic acid gas at 50° C., or at a higher temperature, and expose it to increasing pressure till 150 atmospheres have been reached. In this process its volume will steadily diminish as the pressure augments, and no sudden diminution of volume, without the application of external pressure, will occur at any stage of it. When the full pressure has been applied, let the temperature be allowed to fall till the carbonic acid has reached the ordinary temperature of the atmosphere. During the whole of this operation no breach of continuity has occurred. It begins with a gas, and by a series of gradual changes, presenting nowhere any abrupt alteration of volume or sudden evolution of heat, it ends with a liquid. The closest observation fails to discover anywhere indications of a change of condition in the carbonic acid, or evidence, at any period of the process, of part of it being in one physical state and part in another. That the gas has actually changed into a liquid would, indeed, never have been suspected, had it not shown itself to be so changed by entering into ebullition on the removal of the pressure. For convenience, this process has been divided into two stages, the compression of the carbonic acid and its subsequent cooling; but these operations might have been performed simultaneously, if care were taken so to arrange the application of the pressure and the rate of cooling, that the pressure should not be less than 76 atmospheres when the carbonic acid had cooled to 31°.

We are now prepared for the consideration of the following important question. What is the condition of carbonic acid when it passes, at temperatures above 31°, from the gaseous state down to the volume of the liquid, without giving evidence at any part of the process of liquefaction having occurred? Does it continue in the gaseous state, or does it liquefy, or have we to deal with a new condition of matter? If the experiment were made at 100°, or at a higher temperature, when all indications of a fall had disappeared, the probable answer which would be given to this question is that the gas preserves its gaseous condition during the compression; and few would hesitate to declare this statement to be true, if the pressure, as in Natterer's experiments, were applied to such gases as hydrogen or nitrogen. On the other hand, when the experiment is made with carbonic acid at temperatures a little above 31°, the great fall which occurs at one period of the process would lead to the conjecture that liquefaction had actually taken place, although optical tests carefully applied failed at any time to discover the presence of a liquid in contact with a gas. But against this view it may be urged with great force, that the fact of additional pressure being always required for a further diminution of volume, is opposed to the known laws which hold in the change of bodies from the gaseous to the liquid state. Besides, the higher the temperature to which the gas is compressed, the less the fall becomes, and at last it disappears.

The answer to the foregoing question, according to what appears to me to be the true interpretation of the experiments already described, is to be found in the close and intimate relations which subsist between the gaseous and liquid states of matter. The ordinary gaseous and ordinary liquid states are, in short, only widely separated forms of the same condition of matter, and may be made to pass into one another by a series of gradations so gentle that the passage shall nowhere present any interruption or breach of continuity. From carbonic acid as a perfect gas to carbonic acid as a perfect liquid, the transition we have seen may be accomplished by a continuous process, and the gas and liquid are only distant stages of a long series of continuous physical changes. Under certain conditions of temperature and pressure, carbonic acid finds itself, it is true, in what may be described as a state of instability, and suddenly passes, with the evolution of heat, and without the application of additional pressure or change of temperature, to the volume, which by the continuous process can only be reached through a long and circuitous route. In the abrupt change which here occurs, a marked difference is exhibited, while the process is going on, in the optical and other physical properties of the carbonic acid which has collapsed into the smaller

volume, and of the carbonic acid not yet altered. There is no difficulty here, therefore, in distinguishing between the liquid and the gas. But in other cases the distinction cannot be made; and under many of the conditions I have described it would be vain to attempt to assign carbonic acid to the liquid rather than the gaseous state. Carbonic acid, at the temperature of 35·5°, and under a pressure of 108 atmospheres, is reduced to 1-430th of the volume it occupied under a pressure of one atmosphere; but if any one ask whether it is now in the gaseous or liquid state, the question does not, I believe, admit of a positive reply. Carbonic acid at 35·5°, and under 108 atmospheres of pressure, stands nearly midway between the gas and the liquid; and we have no valid grounds for assigning it to the one form of matter any more than to the other. The same observation would apply with even greater force to the state in which carbonic acid exists at higher temperatures and under greater pressures than those just mentioned. In the original experiment of Cagniard de la Tour, that distinguished physicist inferred that the liquid had disappeared, and had changed into a gas. A slight modification of the conditions of his experiment would have led him to the opposite conclusion, that what had been before a gas was changed into a liquid. These conditions are, in short, the intermediate states which matter assumes in passing, without sudden change of volume, or abrupt evolution of heat, from the ordinary liquid to the ordinary gaseous state.

In the foregoing observations I have avoided all reference to the molecular forces brought into play in these experiments. The resistance of liquids and gases to external pressure tending to produce a diminution of volume, proves the existence of an internal force of an expansive or resisting character. On the other hand, the sudden diminution of volume, without the application of additional pressure externally, which occurs when a gas is compressed, at any temperature below the critical point, to the volume at which liquefaction begins, can scarcely be explained without assuming that a molecular force of great attractive power comes here into operation, and overcomes the resistance to diminution of volume, which commonly requires the application of external force. When the passage from the gaseous to the liquid state is effected by the continuous process described in the foregoing pages, these molecular forces are so modified as to be unable at any stage of the process to overcome alone the resistance of the fluid to change of volume.

The properties described in this communication, as exhibited by carbonic acid, are not peculiar to it, but are generally true of all bodies which can be obtained as gases and liquids. Nitrous oxide, hydrochloric acid, ammonia, sulphuric ether, and sulphuret of carbon, all exhibited, at fixed pressures and temperatures, critical points, and rapid changes of volume with flickering movements, when the temperature or pressure was changed in the neighbourhood of those points. The critical points of some of these bodies were above 100°; and in order to make the observations, it was necessary to bend the capillary tube before the commencement of the experiment, and to heat it in a bath of paraffin or oil of vitriol.

The distinction between a gas and vapour has hitherto been founded on principles which are altogether arbitrary. Ether in the state of gas is called a vapour, while sulphurous acid in the same state is called a gas; yet they are both vapours, the one derived from a liquid boiling at 35°, the other from a liquid boiling at −10°. The distinction is thus determined by the trivial condition of the boiling point of the liquid, under the ordinary pressure of the atmosphere, being higher or lower than the ordinary temperature of the atmosphere. Such a distinction may have some advantages for practical reference, but it has no scientific value. The critical point of temperature affords a criterion for distinguishing a vapour from a gas, if it be considered important to maintain the distinction at all. Many of the properties of vapours depend on the gas and liquid being present in contact with one another; and this, we have seen, can only occur at temperatures below the critical point. We may accordingly define a vapour to be a gas at any temperature under its critical point. According to this definition, a vapour may, by pressure alone, be changed into a liquid, and may therefore exist in presence of its own liquid; while a gas cannot be liquefied by pressure, that is, so changed by pressure as to become a visible liquid distinguished by a surface of demarcation from the gas. If this definition be accepted, carbonic acid will be a vapour below 31°, a gas above that temperature; ether, a vapour below 200°, a gas above that temperature.

We have seen that the gaseous and liquid states are only distant stages of the same condition of matter, and are capable of passing into one another by a process of continuous change. A problem of far greater difficulty yet remains to be solved, the possible continuity of the liquid and solid states of matter. The fine discovery made some years ago by James Thomson, of the influence of pressure on the temperature at which liquefaction occurs, and verified experimentally by Sir W. Thomson, points, as it appears to me, to the direction this inquiry must take; and in the case at least of those bodies which expand in liquefying, and whose melting points are raised by pressure, the transition may possibly be effected. But this must be a subject for future investigation; and for the present I will not venture to go beyond the conclusion I have already drawn from direct experiment, that the gaseous and liquid forms of matter may be transformed into one another by a series of continuous and unbroken changes.

NOTE ON THE ACTION OF IODINE ON HYPOSULPHITE.*

BY C. R. A. WRIGHT, B.SC., F.C.S.

In a paper on the valuation of manganese ores, read before the Newcastle Chemical Society, on November 25th, 1869, Messrs. Sherer and Rumpf state that they find it necessary to titrate the iodine solution obtained by Bunsen's process with standard hyposulphite solution "as soon as possible after the decomposition, since the solution, in presence of air, gradually reacts on the iodide of potassium and liberates iodine;" the iodine solutions in each of two experiments requiring an amount of hyposulphite corresponding to 62·7 per cent of available peroxide in the manganese ore assayed when tested immediately after the decomposition, and to over 65 per cent after standing twenty-four hours; Fresenius and Will's process giving, with the same sample, the intermediate number, 63·5 per cent.

In order to see how far this discrepancy might be accounted for by a possible irregularity in the action of

* Read before the Newcastle-upon-Tyne Chemical Society, February 24th, 1870.

iodine on hyposulphite under different circumstances, as to temperature, &c., a solution of iodine in potassium iodide was prepared of the strength of 5 grms. free iodine to the litre; a solution of pure re-crystallised sodium hyposulphite was also prepared.

Into each of eleven flasks 25·65 c.c. of this hyposulphite was measured by a pipette delivering that amount; about 200 c.c. of water was added to each. In the first flask the quantity of iodine solution requisite to produce a blue tint along with starch, at the ordinary temperature of the air (16° C.) was determined; the second flask was heated to about 60°C., then allowed to cool, and finally titrated as before: almost the same amount of iodine being required, it appears that simply heating the hyposulphite solution does not appreciably alter the quantity of hyposulphite present.

The next eight flasks were heated to varying temperatures, and, while hot, a quantity of iodine solution, rather less than that required for the hyposulphite, as deduced from the first experiments, was added, care being taken to run the iodine direct into the warm liquid, and not down the sides of the flask, which might cause a loss of iodine by volatilisation; no smell of iodine was observed in any case. The addition of this iodine solution slightly cooling the liquids, their temperatures were again read off, the mean of the two temperatures being taken as the average; the warm liquids were then rapidly cooled by immersion of the flasks in cold water, and finally the slight excess of hyposulphite determined by iodine solution; the cooling was essential, since heat destroys the colour of the iodised starch.

The last flask was again titrated at the temperature of the air (16° C.) at the close of the experiments, to make sure that the hyposulphite had not altered spontaneously.

The numbers obtained were—

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
Temperature of solution before addition of iodine solution	—	—	32	40	52	55	86	88	100	100	—
Do. after	—	—	28	36	44	46	65	78	83	85	—
Mean temperature	16 C.	25	30	38	48	50	75	83	91	92	16
C.c. of iodine required	39·6	39·4	39·8	40·0	40·1	40·1	40·7	40·9	41·4	41·2	39·5
Iodine required in excess of that normally requisite, viz., 39·5 c.c.	—	—	0·3	0·5	0·6	0·6	1·2	1·4	1·9	1·7	—
Do. in per cents of the normal quantity	—	—	0·75	1·25	1·5	1·5	3·0	3·5	4·75	4·25	—

From these numbers it is evident that the higher the temperature the larger is the quantity of iodine requisite before a blue colour with starch is developed, *i.e.*, the action of iodine on hyposulphite is slightly irregular at varying temperatures. Since the first action of iodine is to form tetrathionate (which, as is well known, is converted into sulphate by the action of chlorine), it appears probable that the conversion of tetrathionate into sulphate by iodine may account for the excess required. Probably, therefore, if the mode of experimenting were reversed (*i.e.*, hyposulphite added to warm iodine solution, the latter being always in excess till just the close of the experiment), a greater discrepancy would be manifest. It is difficult, however, to manipulate thus without loss of iodine by volatilisation; but it was found that an excess of iodine added to hyposulphite gradually diminished on standing some hours at the ordinary temperature, *i.e.*, less residual free iodine was found after standing than was present immediately after the addition to the hyposulphite.

Thus, 25·65 c.c. of a rather weaker hyposulphite solution than that previously used was pipetted off into each of ten well stoppered bottles; two were immediately titrated with the former iodine solution, the requisite amount of iodine as thus deduced was added to each of the others; to five of them a varying excess of iodine, and to the remaining three a varying excess of hyposulphite; thus, each of the eight originally contained the same amount of tetrathionate. After standing 24 hours in a cupboard (in the dark) at the ordinary temperature (10° —20° C.), hyposulphite was added in slight excess to the five in which the iodine was originally in excess, and finally, all were titrated with the iodine solution. The following numbers were obtained:—

	Original excess of Hyposulphite.	Original excess of Iodine.	Total Hyposulphite used.	Iodine equivalent to Hyposulphite (deduced from A. and B).	Total Iodine used.	Ratio of Iodine and Hyposulphite used.
A.*	—	—	25·65	—	63·3	2·467
B.*	—	—	25·63	—	63·35	2·470
C.	—	0·1	26·25	64·8	64·9	2·472
D.	—	0·2	26·4	65·2	65·1	2·466
E.	—	6·7	28·2	69·6	72·7	2·578
F.	—	16·7	31·85	78·6	82·0	2·574
G.	—	36·7	37.85	93.6	101·9	2·692
H.	1·5	—	27·45	67·8	67·9	2·474
I.	5·9	—	31·50	77·8	77·65	2·465
J.	9·7	—	35·25	87·05	87·2	2·474

* Titrated at once.

From these numbers it appears that in the three last experiments there was no action whatever between the tetrathionate present and the excess of hyposulphite; while in experiments E, F, and G, a considerable amount of iodine has *disappeared*, this amount increasing with the original excess of iodine, thus—

	E.	F.	G.
Excess of iodine	6·7	16·7	36·7
Iodine disappeared	3·1	3·4	8·3
Ditto, in per cents of the normal amount	4·4	3·4	8·9

Similarly, in another experiment with the above iodine solution diluted to one-third its former strength, after 24 hours—

Original excess of iodine	5 c.c.	13 c.c.
Iodine corresponding to total hyposulphite used	163·1	164·4
Total iodine used	166·7	169·9
Excess of iodine	3·6	5·5
Ditto, in per cents of normal quantity	2·1	3·3

On the whole, therefore, these experiments indicate that when the temperature is not lower than 28° C., or when a mixed solution of hyposulphite and iodine still in excess is allowed to stand some time before finishing the titration, a deficiency in the amount of iodine may be expected, varying in amount with the circumstances: possibly, these facts may account for the results obtained by Messrs. Scherer and Rumpf.

The fact that sulphate is formed by the prolonged action of iodine on tetrathionate is indicated by the following experiments:—50 c.c. of the hyposulphite

solution used in the past experiments were mixed with 150 of iodine (large excess); after standing 48 hours at the ordinary temperature in the dark, hyposulphite was added till all free iodine disappeared: chloride of barium gave with this liquid a dense cloud, which, after standing, was collected, and found by the blowpipe to be really barium sulphate. 50 c.c. of the original hyposulphate with barium chloride gave not the slightest precipitate; after addition of a few drops of hydrochloric acid the solution did not become opalescent for a minute or more; and the precipitated sulphur after standing some hours was wholly volatile, showing that no sulphate whatever was present originally in the hyposulphite.

My best thanks are due to Mr. I. L. Bell, in whose laboratory the above experiments were carried out.

CONCERNING

ATOM-FIXING AND ATOM-DISPLACING POWERS.

BY WALTER NOEL HARTLEY, F.C.S.

Part I.

In Hofmann's "Modern Chemistry" occur these words: "The atomic relations which we call quantivalence imply not only atom-fixing, but also atom-displacing power; so that, in learning how many standard units of quantivalence any given elementary atom may attract and retain within a compound molecule, we learn, also, how many it can remove therefrom." According to notions now received, and facts recorded, this, with a certain class of compounds, would appear not to be the case. In Hofmann's work, nitrogen and its congeners are treated as merely trivalent; but they are now well known to have pentad functions.

Many compounds have been obtained by Griess,* in which N substitutes H_3, for instance—

$C_6H_2(NO_2)_2N_2O$,	Azopicramic acid.
$C_{12}H_{11}N_3$,	Azodianiline.
$C_{12}H_8N_4$,	Diazodianiline.

I can find, however, no instance of its displacing five standard atoms; on the other hand, in ammonium-chloride it fixes five. Here, then, is an example, showing that atom-fixing is not identical with atom-displacing power. Again, P, which is trivalent to H, is both a triad and a pentad to Cl—*e. g.*, $PCl_3.PCl_5$. From consideration of these and similar facts, I believe that, in certain elements, the full atom-fixing or displacing power is not exercised, but is partially suppressed or lies latent. For instance, Strecker obtained azobenzoic acid, in which N displaces only one atom of hydrogen, $C_{14}H_{10}N_2O_4$; by treating this with ferrous hydrate, the N takes up H; by boiling with hydrochloric acid, one other atom, H; and subsequently it fixes HCl, thus:—

$C_{14}H_{10}N_2O_4$.	$C_{14}H_{12}N_2O_4$.	$C_7H_7NO_2$.	$C_7H_7NO_2$—HCl.
Azobenzoic acid.	Hydrazobenzoic acid.	Amidobenzoic acid.	Amidobenzoic hydrochloride.

In the first instance, four atom-fixing powers lie latent, and they are gradually revealed until a saturated compound results.

Elements of the nitrogen class † have a much greater power of fixing three atoms than five, their most stable compounds being triadic; in fact, these compounds act as bivalent radicles, and fix two other atoms, thus:—

$$NH_3HCl, \quad PCl_3.Cl_2, \quad SbCl_3.Cl_2,$$

just as certain oxygen compounds do—*e. g.*,

$$NO''Cl_2, \quad PO''Cl_2.$$

This is an instance of what is invariably the case—viz., that the saturating power, or quantivalence, of a compound radicle is dependent on the quantivalence of the elements entering into its composition. Seeing that, in Griess's compounds, N displaces three, instead of five atoms, and, on the other hand, in NH_4HCl it fixes five, we may infer that the two weaker atom-fixing powers are incapable of displacing atoms, although they have the power of fixing them on to a molecule. The amides bear this out: NH_2 can fix three atoms; it displaces only one, however, and then fixes other two, thus—

$C_7H_5(H_2N)O_2$.	$C_7H_5(H_2N)O_2.HCl$.
Amidobenzoic acid.	Amidobenzoic hydrochloride.
$C_3H_5(H_2N)O_2$.	$C_3H_5(H_2N)O_2.HCl$.
Alanine.	Alanine hydrochloride.

Amidogen never displaces three atoms of hydrogen from a compound, because atom-fixing is not identical with atom-displacing power.

The compound HCN has the H combined with the C. Nitrogen being a pentad, the carbon is insufficient to saturate it; we have, therefore, two free atom-fixing powers of the nitrogen in this body. Naquet mentions this in his "Cours de Chimie." The cyanides then have the following constitution:—

$$\text{Cyanides,} \quad C^{IV} \left\{ \begin{matrix} N^{V} \\ M \end{matrix} \right.$$

$$\text{Isocyanides,} \quad N^{V} \left\{ \begin{matrix} C^{IV} \\ M \end{matrix} \right.$$

M = a metallic body.

Cyanogen is, then, a trivalent radicle; the crystalline compounds of Gauthier and Gal, of prussic acid with the haloid acids, abolish the need of any further proof of this.

$$HCN.HCl, \ HCN.HBr, \ HCN.HI, \text{ or } C^{IV} \left\{ \begin{matrix} N^{V} \\ H \end{matrix} \right. .HCl.$$

Hydrocyanic acid is a tertiary monamine, in which the radicle CH'' replaces three hydrogen atoms—

$$CH''' \}N.HCl.$$

The double cyanides of silver and potassium, also chlorocyanide of silver and potassium, may be thus represented:—

$$\begin{matrix} CN—Ag \\ \| \\ K—CN \end{matrix} \qquad \text{or} \qquad CN''' \left\{ \begin{matrix} Ag \\ K \\ Cl \end{matrix} \right.$$

A trivalent radicle, when doubled to form one molecule, may become either tetrad or dyad; when trebled, either monad, triad, or pentad, in its functions, according to its inner constitution, thus:—

$$2(X''') = (\text{molecule})^{\text{IV or II.}}$$

$$3(X''') = (\text{molecule})^{\text{I, III, or V.}}$$

From this it is easy to see how the immense variety of complicated cyanides arise; to take the mercury compounds first, we have—

* *Ann. Chem. und Pharm.*, vol. cxiii., p. 201.
† Odling, in Watts's "Dictionary."

$(Hg''Cy_2)''.KBr.$ $C_2H_3Cy.CyCl.$
$(Hg''Cy_2)''.NaBr.$ $C_2H_5Cy.CO''Cl_2.$
$(Hg''Cy_2)''.NH_4Cl.$
$(Hg''Cy_2)''.KCl.$
$(Hg''Cy_2)''.NaCl.$
$(Hg''Cy_2)''.KI.$
$(Hg''Cy_2)''.Ag.NO_3.$

Of all unstable substances, cyanide of ammonium is most strangely so; it gives off ammonia and hydrocyanic acid at ordinary temperatures, and simultaneously. The reason of this is apparent when we consider that the weaker atom-fixing powers of the nitrogen in the ammonium are united to the weaker ones of the same element in the hydrocyanic acid, thus:—

$$\left.\begin{matrix}H\\H\\H\end{matrix}\right\}\overset{v}{N}.NCH, \quad \text{or} \quad \begin{matrix}\overset{v}{N}\equiv\overset{II}{C}\,H\\ \|\\ H_3\equiv N\end{matrix}$$

Amidogen, H_2N, is an analogue of cyanogen—that is to say, it replaces an atom of hydrogen or chlorine in various compounds.

It is evident that it resembles it closely, in being trivalent as well as univalent, in the same manner as cyanogen, by virtue of the two weaker atom-fixing powers of its nitrogen. The ammonium haloid salts resemble the compounds of Gauthier and Gal, thus:—

$(Cy'''H.)''HCl.$
$(Am'''H)''.HCl.$

It is only necessary to recall the fact that amidogen displaces H from a molecule, and then fixes HCl in order to prove its trivalency.

Chlorine and its congeners form an exceedingly well-defined group of radicles; any compound into which one of these enters is sure to have its analogue, in which the others take part. In addition, however, to the halogens, the mono-metallic bodies come under the same quantivalential class; they form analogous compounds, have the same atomic heat,* and the same capability of displacing each other.

These elements, resembling each other to such an extent in their general powers of forming and entering into compounds, are—

H.	Tl.
K.	Au.
Na.	F. (?)
Ag.	Cl.
Cæ. (?)	Br.
R. (?)	I.

Of this list, thallium and gold are always admitted to be triads; iodine was shown by Schutzenberger † to be a triad; and Wanklyn has shown the possibility of sodium possessing triad functions. The compounds relating to this question are the following:—

$$\underbrace{I\left\{\begin{matrix}Cl\\Cl\\Cl\end{matrix}\right.}_{\text{Iodine trichloride.}} \qquad \underbrace{\left.\begin{matrix}C_2H_2\\C_2H_2\\C_2H_2\end{matrix}\right\}I\left\{\begin{matrix}HO_2\\HO_2\\HO_2\end{matrix}\right.}_{\text{Iodotriacetic acid.}} \qquad \underbrace{Na\left\{\begin{matrix}C_2H_3O\\C_2H_3O\\C_2H_3O\end{matrix}\right.}_{\text{Sodium triacetyl.}}$$

$$\text{Thallic chloride, } Tl\left\{\begin{matrix}Cl\\Cl\\Cl\end{matrix}\right. \qquad \text{Gold chloride, } Au\left\{\begin{matrix}Cl\\Cl\\Cl\end{matrix}\right.$$

Of the above twelve elements, three are comparatively little known—Cæ, R, and F; of the remaining nine, four are shown to be triads, but their monad characters are the much more marked, just as in the nitrogen group. The trivalent are more predominant than the pentad functions; the reason of this I consider to be the same in each case; two of the atom-fixing powers in each class of radicles are weaker than the others. As nitrogen and its congeners have a greater power of combining with three than five atoms, so these elements have a greater power of combining with one than three. It is not at all satisfactory, when contemplating such compounds as sodium-triacetyl, iodo-triacetic acid, and iodic chloride, to be unable to account for these under the orthodox views; it rids us of the difficulty; but it is still less satisfactory to ignore their existence altogether.

A monad atom can form only one combination with any other monad; this is represented by XA; it is a union of atom with atom. It is impossible for this combination to unite with anything else, both elements being saturated.

Let us consider now what combinations of iodine—for instance, with univalent radicles, and apparently saturated compounds, exist.

$$\underset{(a)}{KI.ICl_3} \qquad \underset{(b)}{N\left\{\begin{matrix}(CH_3)_4\\I_3\end{matrix}\right.} \qquad \underset{(c)}{N\left\{\begin{matrix}(CH_3)_4\\I\end{matrix}\right.} \qquad \underset{(d)}{N\left\{\begin{matrix}(CH_3)_4\\I_{10}\end{matrix}\right.}$$

How is it possible to account for these?

Recognise I as trivalent, and the problem is without difficulty.

$$2 \text{ atoms } I = (I_2)^{\text{II or IV}}$$
$$3 \text{ atoms } I = (I_3)^{\text{I, III, or V}}$$

In (*a*), the iodine of the potassium unites with that of the thallium, and together they form a di or tetra molecule, to saturate K and Tl. With (*b*) and (*c*), the molecules* (I_3''') and (I_5''') are both univalent, and therefore fill up the unsaturated combinations—

$$N\{(CH_3)_4.$$

The substance (*d*) is more unstable than the others, which is natural from its being, perhaps, an unsaturated molecule—

$$N\left\{\begin{matrix}(CH_3)_4\\I_{10}\end{matrix}\right.$$

It is possible, however, it results from such a combination as this—

$$N\left\{\begin{matrix}(CH_3)_4 & (CH_3)\\ & (I_{20})''\end{matrix}\right\}N.$$

In either case, it does not affect the question. As for chlorine, if purely univalent in its functions, what is to become of the following bodies?

$$\underbrace{N\left\{\begin{matrix}(CH_3)_4\\ICl_2\end{matrix}\right. \qquad N\left\{\begin{matrix}(CH_3)_4\\ICl_3\end{matrix}\right. \qquad N\left\{\begin{matrix}(CH_3)_4\\ICl_4\end{matrix}\right.}_{\text{Chloriodides.}} \quad \text{(Weltzien).}$$

It is evident their constitution is similar to that of the iodides. A few instances of double chlorides will further strengthen the evidence of triad character, *e.g.*—

$KCl+HgCl_2 = KHg.(Cl_2''')''$
$KCl+ICl_3 = K.(ICl_4)'$
$NaCl+PtCl_2 = NaPt''.(Cl_3)'''$
$NH_4Cl+AgCl = (NH_4)Ag.(Cl_2)''$

Bromine is no exception; but fluorine I am inclined to believe to be a dyad, as suggested by Mr. Gore.†

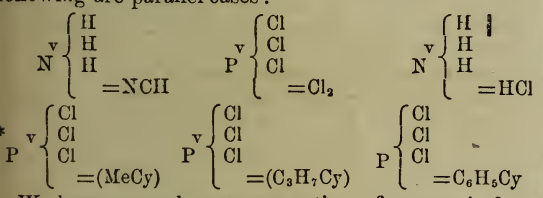
* Canizzaro.
† Wurtz ("Philosophie Chimique").

* The word molecule I use to signify a group of atoms merely.
† *Proceedings of the Royal Society*, 1869.

If H and Cl be monad elements, in combination they will completely saturate each other; how comes it, then, that a completely saturated compound should unite with H_3N, a ready-formed molecule? These weaker atom-fixing powers of the nitrogen must have the power of splitting up the HCl, in order, first, to fix the atom H, and then the Cl to it; again, at a temperature of 300° C., or thereabouts, ammonium-chloride parts with HCl, again unchanged.

Now, if the constitution of sal ammoniac be—

It is only reasonable to expect that heat would drive off, first, either the chlorine or the hydrogen, in which case Pebal, in his experiments proving dissociation, would have found free chlorine: but no; we find the H and Cl coming off in combination. Consider chlorine from the new point of view, and chloride of ammonium like the cyanide, and then how plain is everything—$(NH_3)''.(HCl)''$. NH_3 and HCl are both divalent molecules: they combine and separate without disturbance. The following are parallel cases:—



We have no such easy separation of ammonia from its combinations with oxyacids; from phosphoric acid, a red heat is necessary to remove it; the nitrate decomposes in nitrous oxide and water, &c. On the other hand, another halogen salt, the iodide, decomposes at ordinary temperatures. A further illustration of the same decomposition, giving rise to an anomalous vapour density, is furnished by the bromhydride of amylene, $(C_{10}H_{10})''.H\,Br.''$

As further evidence that various chlorides are not saturated compounds, and thus resemble hydrochloric acid, although the metallic or other radicles are combined with chlorine to their greatest extent, I will quote a few examples of nitriles united with chlorides:—

$Ti\,Cl_4.\,HCN$.†	$Ti\,Cl_4.MeCy$.§	$Ti\,Cl_4.EtCy$.
$Sn\,Cl_4.2HCN$.‡	$Sn\,Cl_4.MeCy$.	$Sn\,Cl_4\,EtCy$.
$Sb\,Cl_5.3HCN$.‡	$Sb\,Cl_5.MeCy$.	$Sb\,Cl_5.EtCy$.
$Fe_2Cl_3.2HCN$.‡	$Fe_2Cl_3.MeCy$.	$Fe_2Cl_3\,EtCy$.
	&c., &c.	&c., &c.

$Sb\,Cl_5.CyCl$.‡
$Bo\,Cl_3.CyCl$. (Martius.) $EtCy.CyCl$.
$Fe_2Cl_3.CyCl$‡
$Ti\,Cl_4.CyCl$.

London, Feb. 24, 1870.

ON THE

ACTION OF SODIUM ON ACETIC ETHER.

BY J. ALFRED WANKLYN.

In reply to Frankland and Duppa's note on this subject, read before the Royal Society on Thursday last, I wish to point out that, in addition to the obvious source of fallacy arising from the presence of alcohol in the acetic ether taken for experiment, there is another fallacy depending upon the production of alcohol by secondary action during the course of the experiment. This secondary action consists in the now well-known reaction between acetic ether and ethylate of sodium, whereby acetate of ethylene-sodium and alcohol are formed. If the details of Frankland and Duppa's paper be examined, it will be found that they have given no adequate proof of the original purity of the acetic ether employed by them, and that they have operated under conditions eminently favourable for the production of alcohol by action of acetic ether on the ethylate of sodium, which is an admitted product of the action of sodium on the ether. The high temperature (130° C. they tell us) and the great length of time taken for the experiment, viz., several days, afford these favourable conditions.

I have no doubt that every trace of hydrogen obtained by Frankland and Duppa proceeded from alcohol.

The explanation which these chemists have offered in order to account for my not getting hydrogen, will, I think, not find general acceptance. In the instance of acetate of amyl, which did not give a trace of gas, I operated under little more than ordinary atmospheric pressure, for this ether boils at 140° C., and I heated only to 100° C. And, finally, I found that potassium dissolves without effervescence in pure acetic ether contained in an open vessel at ordinary atmospheric pressure. In 1840, Löwig published a similar assertion on the action of potassium on acetic ether.

ON THE

REACTION OF CHLORINE ON SULPHUR SALTS.*

The following experiments, made some years ago in the laboratory of Owen's College, under the superintendence of Dr. Roscoe, may be of some interest as bearing on the action of chlorine and its congeners on the sulphur-acids.

In order to see how far the action of equivalent quantities of chlorine, bromine, and iodine on the same sulphurous-acid solution are comparable, solutions were prepared, one containing 5 grms. of iodine per litre, and the other such a quantity of sulphurous acid that a litre represented about 150 c.c. of the iodine solution. The exact relation between the two was determined before and after each set of experiments; and it was found that no appreciable alteration took place during the duration of any one set of experiments. A solution of washed chlorine in distilled water was also prepared, and kept in the dark, and, when required, diluted with distilled water to the required strength. The stronger solutions were weighed out in sealed glass bulbs, subsequently broken under the surface of the liquids to be acted on.

(*a*). Known quantities of chlorine solution were added to a measured column of sulphurous-acid solution, the latter being in slight excess. This excess was then titrated by the standard iodine solution.

(*b*). Cl solution was added to potassium-iodide solu-

* Henke (*Ann. der Chem. und Pharm.*, vol. cvi., p. 272).
† Wöhler (*Ann. der Chem. und Pharm.*, vol. lxxiii., p. 226).
‡ Klein (*Ann. der Chem. und Pharm.*, vol. lxxiv., p. 86).
§ Henke (*Ann. der Chem. und Pharm.*, vol. cvi., p. 280).

* Read before the Newcastle-on-Tyne Chemical Society, Feb. 24th, 1870, continued from last number.

tion, and the liberated iodine treated as the chlorine in (*a*).

(*c*). Carried out as (*b*), but potassium bromide used instead of iodide.

(*d*). Bromine liberated, as in (*d*), by Cl and KBr; KI then added, and the iodine thus liberated by bromine treated as that obtained in (*b*).

By subtracting from the iodine solution equivalent to the sulphurous acid used that required for the back titration, numbers were obtained representing the amount of iodine solution equivalent to sulphurous acid destroyed by chlorine, bromine, or iodine in these experiments. Each determination was done in duplicate, frequently in triplicate; and it is noticeable that, whilst the repetitions agreed remarkably closely in all cases where iodine acted on sulphurous acid, they usually showed some little divergence in the case of bromine, and considerably more in the case of chlorine.

Care was taken in all these comparative experiments to have the total volume of liquid in each case as nearly as possible proportionate to the quantity of chlorine originally employed, so that the circumstances of dilution in any set of experiments should be approximately uniform.

The following examples show the character of the numbers obtained, the same measured volume of chlorine solution, containing 0·88 grms. of Cl per litre, being used in each instance.

Iodine representing SO_2 destroyed by I (liberated by Cl and KI).	Iodine representing SO_2 destroyed by I (liberated by Cl and KBr, and by Br thus set free, and KI).	Iodine representing SO_2 destroyed by Cl.	Iodine representing SO_2 destroyed by Br.
c.c.	c.c.	c.c.	c.c.
63·1	62·8	61·6	62·7
62·9	62·6	61·3	62·6
63·1	62·7	60·9	62·7
Mean 63·0	62·2	61·3	62·7

Similarly, with other chlorine solutions, the following mean numbers were obtained from eighteen determinations:—

Grms. of chlorine per litre of solution.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by Cl.	Iodine representing SO_2 destroyed by Br.
*7·00	49·8	44·5	51·3
0·30	57·0	56·5	56·9

The above numbers, calculated in each case to 100 parts of iodine, representing SO_2 destroyed by I (Cl and KI), are—

Grms. of Cl per litre of solution.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by I (from Cl and KBr, and from this B and KI).	Iodine representing SO_2 destroyed by Cl.	Iodine representing SO_2 destroyed by Br.
7·00	100·0	—	89·2	103·0
0·88	100·0	99·5	97·1	99·5
0·30	100·0	—	99·2	99·9

It thus appears that the action of iodine is nearly the same, whether directly set free by Cl, or liberated by the circuitous process of evolving bromine from Cl and KBr, and then causing this bromine to act on KI, since the numbers obtained are no more different than might be anticipated from the combined effects of experimental errors, volatility of bromine, &c.; whilst the action of bromine in the two weaker solutions appears to be nearly the same as that of iodine; whereas, in the stronger solution, a larger quantity of SO_2 is destroyed by bromine than by iodine. Lastly, the action of chlorine appears, in the weakest solution, to be nearly identical with that of iodine, but, in the stronger solutions, differs considerably therefrom, and this difference, unlike that in the case of bromine, indicates a destruction of *less* SO_2 by chlorine than by an equivalent quantity of iodine.

From a similarly-conducted series of twenty-four determinations, the following mean numbers were also obtained as the relative actions of chlorine and iodine solutions:—

Grms. of Cl per litre of solution.	Iodine representing SO destroyed by I from Cl and KI.	Iodine representing SO_2 destroyed by Cl.
4·40	100·0	94·7
2·41	100·0	95·4
1·39	100·0	114·4
0·94	100·0	105·4

Experiments were also performed with gaseous chlorine. A known weight of potassium dichromate was treated with hydrochloric acid, in Bunsen's apparatus, and the liberated chlorine led directly into a known slight excess of sulphurous-acid solution, subsequently titrated back by the standard iodine. The iodine solution having been originally standardised from the amount of iodine set free by making the chlorine from a known quantity of dichromate act on potassium iodide, the relative actions of chlorine and iodine were directly calculable. In three experiments, the following numbers were obtained:—

Grms. of chlorine evolved per litre of sulphurous-acid solution employed.	Iodine representing SO_2 destroyed by I (from Cl and KI).	Iodine representing SO_2 destroyed by gaseous Cl.
0·36	100·0	109·8
0·33	100·0	113·0
0·33	100·0	112·8

It is clear, from the above-described experiments, that the difference in the action of chlorine and iodine does not depend solely on the strength of the solutions used. Probably temperature and photo-chemical action are also concerned.

Assuming that the action of iodine on sulphurous acid, under the circumstance experimented on, is always represented by the equation $H_2SO_3 + H_2O + I_2 = 2HI + H_2SO_4$, it is evident that chlorine or bromine *might* cause the destruction of *more* SO_2 than corresponds to this equation, if their actions caused the formation of thionic acids. Thus, for tetrathionate, which as the preceding experiments show, is only slowly acted on by iodine,

$$\underset{\text{Tetrathionic acid.}}{7H_2SO_3 = H_2S_4O_6 + 3H_2O + 3H_2SO_4}.$$

But how it happens that a *less* quantity of SO_2 is sometimes destroyed by chlorine than by the equivalent amount of iodine is more difficult to explain. Possibly, though this does not seem a very probable supposition, under the influence of light or of other unknown circumstances, free oxygen may be found which escapes without exerting its due influence on the sulphurous acid—

$$2H_2O + 2Cl_2 = 4HCl + O_2.$$

That free oxygen in aqueous solution acts compara-

* Nearly saturated Cl solution, containing, at 0°, 2·2 vols. of Cl gas to 1 vol. of water.

tively slowly, at any rate in the dark, on sulphurous acid solution, is shown by the following numbers:—A quantity of saturated sulphurous acid solution was largely diluted with water, saturated with air, and kept in a well-closed opaque vessel. Samples, taken from time to time, indicated that the oxidising action of the dissolved oxygen lasted a considerable time, eighteen hours elapsing before the action became negligible; thus, a given volume (stoppered vessel containing about 300 c.c.) required—

Immediately after mixture.....	42·3	c.c. of	iodine solution.
10 minutes " "	40·6	"	"
20 minutes " "	40·3	"	"
1 hour " "	40·0	"	"
2 hours " "	39·9	"	"
18 hours " "	39·3	"	"
40 hours " "	39·2	"	"

However, the following experiments indicate that, when the action of chlorine or sulphurous takes place without exposure to daylight, the quantity of acid destroyed is always in excess of that due to the equivalent amount of iodine. The previously-described experiments were performed in the diffused light of a laboratory; but the subsequent ones were all carried out in a cellar only lighted artificially—even the weighings of the chlorine solution being performed there, in order to avoid any possible photo-chemical action.

Weighed bulbs of chlorine solution were broken under known volumes of sulphurous acid, diluted the instant previously with warm or cold water, so as to obtain varying temperatures, and similar determinations were made by breaking chlorine water bulbs under potassium iodide solution at varying temperatures.

From twelve determinations, the following mean numbers were obtained:—

Iodine and Sulphurous acid.		Chlorine and Sulphurous acid.		
Temperature.	Iodine representing SO_2 destroyed by I.	Temperature.	Iodine representing SO_2 destroyed by Cl.	Rates.
14°	104 c.c.	16°	132 c.c.	100 to 127
40°	105 "	35°	186 "	100 to 177

It thus appears that, while variation of temperature makes but little alteration in the action of iodine, it has a great influence on that of chlorine, the difference being the higher the temperature, and always indicates the destruction of more SO_2 by chlorine than by iodine.

To find if the action of chlorine and iodine becomes identical at 0° with any strength of chlorine solution, bulbs containing chlorine water of varying strengths were broken.

(*a*). Under known volumes of sulphurous acid solution at the temperature of the cellar (viz., 12° C. throughout this set of determinations).

(*b*). Under sulphurous acid cooled to 0° by additions of fragments of pure ice (found to have no effect when melted on the iodine solution).

(*c*). Under potassium iodide at 12° and at 0°: the obtained at these two temperatures never differed by more than 0·1 c.c. from one another (out of 40—50 c.c. used).

The following mean numbers were got from thirty-three determinations:—

Grms. of Chlorine per litre of solution.	Iodine representing SO^2 destroyed by I (from Cl and KI).	Iodine representing SO^2 destroyed by Cl at 12° C.	Iodine representing SO^2 destroyed by Cl at 0° C.
*7·20	100·0	106·1	103·4
0·68	100·0	102·5	103·9
0·78	100·0	103·3	102·6

It thus appears that at 0° there is little difference between the action of a saturated solution of Cl and one containing only about one-ninth of that amount.

These experiments would tend to show that, when the action of chlorine or sulphurous acid takes place, not under the influence of light, a larger quantity of acid is destroyed than corresponds to the equation—

$$H_2SO_3 + Cl_2 + H_2O = 2HCl + H_2SO_4,$$

this extra amount varying with the temperature, and, possibly, with the strength of the solution; whilst, if the action takes place in daylight, the result is so modified, that sometimes more, and sometimes less acid is destroyed than that indicated by this equation. In the case of bromine, also, apparently, there is some irregularity in the action under different circumstances, as is shown by the non-uniform results obtained on repetition of determinations. Iodine, on the other hand, as Bunsen has shown (*Ann. der Chem. und Pharm.*, vol. lxxxvi., p. 265), acts with great regularity and uniformity in accordance with this equation under considerably varied circumstances, unless a solution containing more than 0·4 grms. of SO_2 per litre be used.

ON SOME NEW SULPHO-COMPOUNDS.

BY S. E. PHILLIPS.

If botanists were to exercise little or no discrimination between natural and aberrant or monstrous forms, we should make but little progress in the very interesting but difficult problem of botanical arrangement and classification. But chemists are perpetually giving us the most puzzling problems; and their accumulation has landed us in a jargon of types and nomenclature utterly bewildering.

It is in this way M. Schneider has just treated us to some new sulpho-saltic types. Hence the following list (see Chemical News, vol. xx., p. 264; *Am. Repr.*, *Jan.* '70, *page* 51):—

1. Sulphide of silver and iron..... $Ag_2Fe_2S_4$
2. " " iron and sodium..... $Na_2Fe_2S_4$
3. " " bismuth and sodium..... $Na_2Bi_2S_4$
4. " " copper and potassium..... $K_2Cu_8S_6$
5. " " copper and sodium..... $Na_4Cu_6S_6$
6. " " copper, iron, and potassium..... $K_2FeCu_3S_4$
7. " " copper, iron, and sodium..... $Na_2FeCu_3S_4$

We thank him very much for not giving us the rational types of this curious assemblage; whether they are modified types of water or hydrochloric acid, or represent of these arch-types, single, double, or multiple atoms; these are curious points that do not disturb an old chemist. Hence we proceed at once to see how far the old views and intelligible principles may cover the new ground.

The first two would seem to be the most normal form of sulpho-salts for such feeble acid-radicals as copper and iron. The type is a most familiar one, and has a wide range in mineral chemistry. It is that of the corresponding oxy-ferrates and oxy-aluminates—

$$MO + Al_2O_3$$
$$MO + Fe_2O_3$$
$$MS + Fe_2S_3$$
&c.

* Nearly saturated chlorine water.

No. 3 is a simpler form—$NaO + BiO_3$ or $NaS + BiS_3$. The others are more complex, or, at any rate, more unusual, if not hybrid and abnormal.

No. 4 is an utter puzzle, and there is probably some mistake in the figures; or is it possible that any of the varied forms of modern type could resolve such an assemblage of elements?

Nos. 5, 6, and 7 may prove varied or hybrid forms of the common sesqui-type above. This hybridity (or by whatever name it should be called) assumes three forms—

First, in No. 5, one S is replaced by one Cu, a most unusual, but perhaps not an impossible, anomaly. As such, it would be $NaS + CuS_2Cu$. This may appear to some a large measure of faith in the preservation of a generic type; but, on the other hand, it must be observed that this type is well and widely established, and it is only mooted *pro tem.*, until some modern view can supersede it in consistency and simplicity.

Nos. 6 and 7 may be varieties which have two characteristics. The first is a common one, in illustration of which thousands of cases might be cited where Fe replaces Cu, to the preservation of the same type and general properties.

The second one is forced alike upon the attention of old and new chemists, and perhaps has not received that careful attention it so well deserves, though, in some respects, it has been seized hold of and treated as if it were a special part of modern chemical philosophy. I allude to the hypothesis that the ordinary sesqui-sulphide of copper, in these two cases, is a sulphide where two ordinary atoms have a double condensation, and act and re-act as one element. The type of these two bodies would be thus—

$$\left.\begin{matrix} KS+Cu_2S_3 \\ NaS+Cu_2S_3 \end{matrix}\right\} \text{Cu}_2=(Cu_3Fe).$$

As modern chemists have perhaps unwisely abandoned the method of indicating the doubled atoms by a cross-line (thereby occasioning great trouble and perplexity to some who either do not or will not understand the new arrangements), I have here adopted it with a new signification. It bespeaks a molecule of double condensation, but which is not a duad in the modern acceptation—viz., it does not represent the equivalence of 2H, &c. The underlining is a convenient way of referring any common type to a marginal explanation.

The entire philosophy of allotropic or isomeric variation will not be fully embraced by any one feature, but this one has powerfully struck the writer in the course of study for many years past. It seems to take place with both elements and compounds; and one of the earliest instances probably on record, is that of (CO) =14 (the radical of carbonic acid) and (CO)=28 (the radical of oxalic acid), both of which represent 1 atom of H or other equivalent in a variety of substitutional type modifications. We have HH_2,N (ammonia); and, by a generic reaction, carbonic acid gives $(CO)H_2,N$ (carbamide); and, similarly, oxalic acid gives $(CO)H_2,N$ (oxamide), &c., all normal 2-vol. compounds. And these, by a further extension of the same reaction, give carbamic and oxamic acids, &c.

The ammonia and atmonia type affords a striking illustration: it is as if ammonia, $(H_3N)=17$, by an allotropic or double condensation, gave atmonia, $(H_3N=34$; both interchangeably representing one constituent and one vol. in a wide series of combinations.

The precise case here given is, as yet, hypothetical; but the facts are wide and well-known in great extensions.

Ammonia,	HH_2,N	Oxide of ammonium,	HH_3N,O
Ethylia,	EH_5N	" " ethylium,	EH_3N,O
Urea,	$(CO)_2H_4,N_2$	" " urea,	$(CO)_2H_5N_2O$
		&c.	

Whatever the future may unfold in regard to this isomeric condensation, one thing at least is certain—that copper was one of the first elements to force it upon the attention of chemists.

As we have MnO_3 and Mn_2O_7,
So we have NH_3 and N_2H_7;

Such being an old and familiar transitional arrangement *within prescribed limits* of mineral chemistry, the first being a ratio of one to three, the second that of one to three-and-a-half.

If old mineral chemistry has lighted up the path into the profounder depths of organic chemistry, truly may we say she is likely to be repaid with a mighty interest of reflex light and illumination.

It only remains to compare the percentage composition of the old and new types—

		NEW.		OLD.		
1.	Sulphide of silver and iron	Ag_2 ..... 47·38	.....	47·38	Ag	$=AgS+Fe_2S_3$
		Fe_2 ..... 24·56	.....	24·56	Fe_2	
		S_4 ..... 28·06	.....	28·07	S_4	
2.	" iron and sodium	Na_2 ..... 12·43	.....	12·80	Na	$=NaS+Fe_2S_3,HO$
		Fe_2 ..... 31·07	.....	31·28	Fe_2	
		S_4 ..... 35·44	.....	35·75	S_4	
		HO ..... 19·58	.....	20·17	HO	
3.	" bismuth and sodium	N_2 ..... 7·79	.....	7·79	Na	$=NaS+BiS_3$
		Bi_2 ..... 70·51	.....	70·51	Bi	
		S_4 ..... 21·70	.....	21·70	S_4	
4.	" copper and potassium	K_2 ..... 10·05	.....	(?)	(?)	(?)
		Cu_8 ..... 65·27				
		S_6 ..... 24·68				
5.	" copper and sodium	Na_4 ..... 13·84	.....	13·86	Na	$=NaS+Cu_2S_2Cu$
		Cu_6 ..... 57·29	.....	57·11	Cu_3	
		S_6 ..... 28·87	.....	29·03	S_3	
6.	" copper, iron, and potassium	K_2 ..... 17·28	.....	10·994	K	$=KS+\underline{Cu_2}S_3$
		Fe ..... 12·38	.....	13·348	Fe	
		Cu_3 ..... 40·08	.....	45·108	Cu_3	
		S_4 ..... 28·27	.....	30·550	S_3	
7.	" copper, iron, and sodium	Na_2 ..... 10·94	.....	13·457	Na	$=NaS+\underline{Cu_2}S_3$
		Fe ..... 13·32	.....	12·993	Fe	
		Cu_3 ..... 43·50	.....	43·871	Cu_3	
		S_4 ..... 30·44	.....	29·698	S_3	

$\underline{Cu_2}=Cu_3Fe$

As to the nomenclature, nothing could be plainer: they are sulpho-ferrates, sulpho-cuprates, or sulpho-bismuthates of sodium, &c., corresponding with the oxy-ferrates, cuprates, or bismuthates, where we have agreed, in deference to common usage, that the oxy-prefix shall be understood, though unexpressed.

And, just as a sulphate or ferrate means oxy-ferrate of *an oxide*, so sulpho-ferrate or chloro-ferrate means sulpho-ferrate of *a sulphide* or chloro-ferrate of *a chloride*, the latter prefix being implied in the former.

ON A

NEW METHOD OF SEPARATING TIN FROM ARSENIC, ANTIMONY, AND MOLYBDENUM.

BY FRANK WIGGLESWORTH CLARKE, S.B.

Some time since, happening to notice that the remarkable highly-crystalline precipitate formed by oxalic acid in a solution of stannous chloride was not blackened or otherwise affected by sulphuretted hydrogen, I was led to a series of experiments concerning the action of the above-named acid upon certain metallic sulphides, and obtained the following results.

Both sulphides of tin, if moist and freshly precipitated, are readily decomposed by moderately-long boiling with an excess of oxalic acid, H_2S being given off. The monosulphide is converted into the insoluble, crystalline stannous oxalate; while the yellow disulphide is completely dissolved. The commercial "Mosaic gold," however, seems to be unacted upon by the reagent. In presence of an excess of oxalic acid, tin cannot be precipitated by H_2S.

The sulphides of arsenic, even upon very long boiling with the acid, are almost unattacked. Very minute traces of the metal sometimes go into solution, but may be re-precipitated by a bubble or two of H_2S. Accordingly, the presence even of an enormous excess of oxalic acid does not hinder the precipitation of arsenic as sulphide.

The sulphide of antimony behaves in a somewhat different manner. Although, upon long boiling with oxalic acid, considerable quantities of the metal are taken into solution, yet every trace of it may be re-precipitated by H_2S.

Molybdic trisulphide appears to be wholly unattacked by oxalic acid, even upon very long boiling.

With the sulphides of tungsten I have obtained discordant results. Under certain circumstances, they seem to be wholly insoluble in the acid; while, at other times, they are decomposed completely, and partly taken into solution.

By availing myself of the solubility of the sulphides of tin in oxalic acid, I have been enabled to separate tin perfectly from arsenic and molybdenum, and almost perfectly from antimony. When only arsenic and antimony are to be separated from tin, I find it best to proceed as follows:—To the solution containing the three metals (this solution being prepared in the usual manner for the precipitation of the sulphides) I add oxalic acid, in the proportion of about 20 grms. of the reagent for every gramme of tin, taking care to have the whole so concentrated that the acid will crystallise out in the cold. I then heat to boiling, and pass in sulphuretted hydrogen for about twenty minutes. No precipitate appears at first; but, as soon as the liquid is saturated with the gas, the sulphides of arsenic and antimony begin to fall, and, in a very few moments, are completely thrown down. Then, as usual, the whole should be allowed to stand about half-an-hour in a warm place, before filtering. Every trace of arsenic and antimony is precipitated, so that, in the filtrate from the sulphides, neither of these metals can be discovered by Marsh's test, nor can any antimony-stain be produced with zinc upon platinum. I have carefully experimented to learn whether oxalic acid could interfere with either of these tests, and find that it has not the slightest influence upon them. The sulphide of arsenic is absolutely free from tin; but the antimony always carries down a minute trace of that metal with it: this trace, however, if the operation has been carefully performed, can scarcely be detected, and generally may be ignored with safety. If, however, the greatest accuracy is desired, it may be well to redissolve the sulphide of antimony in an alkaline sulphide, decompose the solution with an excess of oxalic acid, boil with a little strong sulphydric-acid water, filter, and add the filtrate to the tin solution previously obtained.

To separate tin from molybdenum, owing to the difficulty of precipitating the latter metal with H_2S, I have been obliged to slightly vary my process. I find that, by adding an alkaline sulphide in excess to a solution containing molybdate, then decomposing the sulphur-salt formed with a considerable quantity of dilute chlorhydric acid, and allowing the whole to stand over night in a warm place, every trace of molybdenum is precipitated. The sulphide thus obtained can be easily washed with a mixture of dilute chlorhydric acid and ammonic chloride. If, now, by this process we throw down tin and molybdenum together, every trace of the former metal may be dissolved out by boiling the mixed sulphides for about three-quarters-of-an-hour with oxalic acid, in the proportions which I have already given. It is best to have present in the solution, while boiling, a little dilute chlorhydric acid.

If antimony, also, is contained in the mixture, it is necessary, just before ceasing to boil, to add to the solution an equal volume of strong sulphydric-acid water, to re-precipitate any of that metal which may have gone into solution. Upon filtering, no molybdenum can be detected in the filtrate by any ordinary tests, and the molybdic sulphide is absolutely free from tin. In all these cases, it is assumed that the tin is in the form of a stannic compound. It must be borne in mind that the lower sulphide of this metal is converted by the acid into an oxalate insoluble in water; but, as the latter dissolves to an almost unlimited extent in dilute HCl, its formation need not interfere with an analysis.

Since the presence of oxalic acid interferes somewhat with the complete precipitation of tin by ordinary methods, I was subjected to some trouble in finding a process for determining that metal after the separation. At last I found it could be thrown down as follows:—The solution, after being rendered slightly alkaline with ammonia, is mixed with enough ammonic sulphide to re-dissolve the precipitate at first formed; an excess of *acetic* acid is added, and the whole allowed to rest several hours in a warm place. *Acetic* acid must be used, for stronger acids would be liable to set free some of the oxalic to re-dissolve the tin. The precipitate, which at first varies from white to pale yellow, rapidly darkens in colour, and seemingly consists of a mixture of oxide and sulphide of tin. It should be washed with a solution of ammonic nitrate, and,

after ignition, is weighed as SnO_2. In two successive experiments, in which I mixed a weighed quantity of tin with unknown proportions of arsenic and antimony, I received of the tin, after making my separation, respectively 99·93 and 99·57 per cent. The loss in the second case was due to my not having allowed the tin-precipitate to settle sufficiently long before filtering —in other words, to incomplete precipitation.

The arsenic and antimony, being in the form of sulphides, may be estimated by any of the ordinary methods. They may be best separated by Bunsen's process with sulphurous acid, which, though far from perfect, is superior to all others. Lensen's method, in which the arsenic is precipitated from the sulphur solution of the two metals as ammonia-magnesian arsenate, is worthless.

A couple of years ago, I made a few experiments upon indirectly determining the proportions of tin and antimony in alloys of the two metals. I oxidised a weighed quantity of the alloy with nitric acid in a porcelain crucible, heated the resulting oxides with ammonic nitrate, and then (regarding the tin as converted into SnO_2, and the antimony into Sb_2O_4) calculated the proportions of the metals from the increase in weight. This method, although by no means giving me accurate results, served very well for rough approximate determinations. I cite it here simply as an easy and convenient process for obtaining a close idea of the constitution of any alloy composed of the two metals. Possibly the metal might be so modified as to give accurate determinations.—*American Journal of Science, Jan.*, 1870.

EXPERIMENTS ON SOME OF THE METHODS FOR EFFECTING THE SEPARATION AND ESTIMATION OF ARSENIC AND COPPER.*

BY E. W. PARNELL.

Probably the oldest and most universal method for effecting the separation of these metals is to treat the mixed sulphides with a solution of an alkaline sulphide, in which the sulphides of arsenic are soluble. Another method is to treat the sulphides with a solution of caustic soda or potash, and conduct a slow stream of chlorine gas into the mixture: the arsenic forms arseniate of soda soluble in water, while the copper is in the form of an insoluble oxide. A third method is to conduct a slow stream of chlorine gas over a mixture of the two metals, sulphides, or otherwise, heated by the flame of a Bunsen's burner: volatile arsenic-chloride is formed, which, when received in water, forms arsenic and hydrochloric acids; the copper remains behind. Another method is to convert all the arsenic into arsenic acid, by treatment with nitric acid or otherwise; add excess of ammonia, and throw down the arsenic as a double arseniate of ammonia and magnesia by the "magnesia mixture;" the copper remains in solution.

The author has attempted to show, by the following experiments, how far accurate results may be obtained by these and other methods of separating the metals, and also by the methods generally used for their estimation.

The Separation of the Metals.

A pure solution of copper was prepared, by dissolving pure, re-crystallised copper-sulphate in distilled water. Pure, freshly-sublimed arsenious oxide was dissolved in a boiling solution of sodium carbonate, to form an arsenic solution. Mixtures of these two solutions were used for experimenting on the methods of separation.

Treatment of the Metallic Sulphides with an Alkaline Sulphide.

A mixture was made from the above solutions, containing about 0·3 grm. of each of the metals. Excess of hydrochloric acid was added, the metals thrown down by sulphuretted hydrogen, the mixed sulphides introduced into a flask, covered with a colourless solution of sodium sulphide, and maintained at a gentle heat on the water-bath for about twelve hours. The liquid was then filtered off, the filtrate separated, and the copper-sulphide on the filter washed with boiling water, to remove every trace of soluble arsenic. The copper-sulphide was then dissolved in nitric acid, the solution evaporated with a small quantity of sulphuric acid, the residue dissolved in water, again treated with sulphuretted hydrogen, the precipitate treated as before with perfectly pure sulphide of sodium, and filtered. The clear solution that would have contained any arsenic that had remained with the copper in the first instance was decomposed with hydrochloric acid, the precipitated sulphur collected, washed, and treated with ammonia, which would dissolve any sulphide of arsenic that might be mixed with it. A little sodium-carbonate was added to the ammoniacal solution, and the liquid evaporated to dryness in a small porcelain dish, the residue mixed with a little potassium cyanide, and the mixture examined for arsenic, by heating it in a glass tube in a slow stream of carbonic acid, in the manner described in Fresenius's "Qualitative Analysis" (German edition, p. 180). A very faint mirror of metallic arsenic was obtained, that could not exceed 1-10th of a milligramme.

The filtrate from the first treatment with sodium sulphide was next decomposed with hydrochloric acid, the precipitate thoroughly washed and dried, and carefully sublimed. No trace of copper remained as a residue. From this, therefore, I conclude that a satisfactory separation can be effected by using a colourless solution of sodium sulphide.

The fact of ammonium sulphide dissolving small quantities of copper sulphide being so well known, the author did not consider it necessary to experiment on this method.

Separation by Conducting Chlorine Gas into an Alkaline Solution in which the Sulphides are Suspended or Dissolved.

A mixture was made, as in the preceding experiment; excess of a solution of potash was added, and a slow stream of chlorine conducted into the liquid until the latter was thoroughly saturated with the gas. The mixture was then boiled, filtered, the insoluble part well washed, and the precipitate and filtrate examined respectively for arsenic and copper, as in the previous examination. The copper was perfectly free from arsenic; but the filtrate contained a small quantity of copper (this was, however, probably due to minute particles of the oxide of copper being carried through the filter, as the oxide was in an exceedingly fine condition: the quantity was very small). Care should be taken to ensure a decided excess of the chlorine, or a considerable quantity of arsenic may remain with the

* Communicated by the Author. Conducted in the Laboratory of Professor Fresenius, Wiesbaden.

copper. I conclude, therefore, that this method can yield accurate results.

Separation effected by Heating the Mixture in a Stream of Chlorine Gas.

A similar mixture to those used in the previous experiments was prepared, excess of hydrochloric acid added, the metals thrown down by sulphuretted hydrogen, the precipitate thoroughly dried and introduced into a bulb-tube, and the separation proceeded with precisely as described in Fresenius's "Quantitative Analysis." A large quantity of copper was found to be carried over with the arsenic into the condensing tube; this would indicate that the heat had been far too high. The next step was to discover at how low a temperature all the arsenic could be decomposed and volatilised. With this object, about 1·0 grm. of pure arsenious trioxide, placed in a small porcelain boat, was introduced into a glass tube; this latter passed through an air-bath, fitted with a thermometer to enable the tube to be maintained at a fixed temperature. A slow stream of chlorine gas was conducted through the tube. In about twenty minutes, the arsenic was entirely converted to an oily-looking, yellow liquid—no doubt the terchloride. The temperature of the bath was then raised to and maintained at 100° C. In about half-an-hour, the liquid was entirely volatilised.

About 1 grm. of sulphide of copper was next treated in a similar manner with a cold stream of chlorine gas. The black mass quickly became yellow. In about an hour it was examined for sulphide, by treating a portion of it with water. A considerable quantity remained undecomposed. The temperature of the bath was then raised to 100 C., and the stream of chlorine conducted, as before, over the mass. After half-an-hour it still contained sulphide. The temperature was then raised to 150° C., and the stream of chlorine continued. After four hours the sulphide was not decomposed. In these experiments, the chlorine gas had not been thoroughly dried by passing it through a tube containing chloride of calcium. It occurred to me, therefore, that the small quantity of moisture the gas would contain might retard its action on the sulphide. To discover if this were the case, a similar quantity was taken, very carefully dried, and treated as before with a stream of the cold, but now thoroughly dried, gas. In about half-an-hour, a portion of the sample was examined for sulphide; it contained only a very small quantity. The action was continued in the cold for about 1½ hours, a minute trace still remained; on warming the tube to about 150° C., and continuing the chlorine stream, this trace quite disappeared.

A mixture of copper and arsenic was then again prepared from the solutions, converted into sulphides as before, filtered, washed, and thoroughly dried. The mixture, contained in a porcelain boat, was introduced into the glass tube. This tube was allowed to project for about 4 inches beyond the air-bath. Perfectly dry chlorine was then conducted over the mixture, maintained at a temperature of about 200° C. In about half-an-hour the action was stopped. The projecting part of the tube, which had been almost cold during the operation, was examined for copper. It contained no trace. The copper in the porcelain boat was found to be completely soluble in weak hydrochloric acid. The solution was precipitated with sulphuretted hydrogen, the precipitate treated with sodium sulphide in a warm place for about four hours, the mixture filtered, and the filtrate carefully examined for arsenic, as before. It did not contain the slightest trace. I gather, therefore, from these experiments that, if proper precautions be taken to ensure perfect dryness of the mixture and the gas, a most perfect separation can be effected at a temperature of about 200° C. To avoid the formation of the globule of sulphur, or mixture of chloride of sulphur and sulphur, which often takes place in the condensing-tube, the precaution should be taken to first saturate the liquid with chlorine, or to use a solution of chlorine for the condensing-liquid.

Separation by Igniting the Mixed Sulphides in a Stream of Hydrogen Gas.

This process, conducted in the usual manner, has only for its object the estimation of the copper, unless, indeed, the amount of sulphur in the mixed sulphides is accurately known, when the amount of arsenic may be calculated from the loss.

To effect the separation, the mixture is introduced into a small porcelain crucible, fitted with a perforated cover and tube for conducting in the gas. A little sulphur is added, a gentle stream of hydrogen conducted into the crucible, and the mixture carefully heated by the lamp, and finally raised to bright redness. A mixture of the two metals was thrown down, as before, with sulphuretted hydrogen, and ignited as just described. The subsulphide of copper was subsequently very carefully examined for arsenic; it did not, however, contain the slightest trace.

Experiments on the Methods for Estimating Arsenic.

About 3·5 grms. of pure, dry arsenious oxide were carefully sublimed in a slow stream of dry air. This re-sublimed arsenious oxide was then weighed (it equalled 2·4090 grms.), and dissolved in a boiling solution of carbonate of soda. I purposed diluting this solution to a certain volume, and measuring off portions for the various estimations. To ascertain the extent of the error that this mode of procedure would introduce, the following experiment was made:—A flask of about 300 c.c. capacity, with rather a narrow neck, was carefully marked, and filled to the mark with distilled water. The water in the flask weighed 281·51 grms. 20 c.c. of the water were then measured off, by a pipette, into a small, weighed beaker. The pipette was allowed to drain for about half-a-minute, resting against the side of the beaker, immediately above the liquid.

The weight of water was found to be—

	grms.
In the first trial	20·037
In the second trial	20·032
In the third trial	20·035
Average of the three trials	20·034

The greatest difference was 3 milligrammes, equivalent to 0·015 per cent. The extent of the error was, therefore, exceedingly small. The solution of arsenious oxide was introduced into the flask above mentioned, diluted to the mark on the neck, and the temperature noted. 20 c.c. of the solution contained, therefore, 0·17145 grm. arsenious oxide.

Estimation by Precipitation as Double Arseniate of Magnesia and Ammonia.

This mode of estimating arsenic (and, indeed, most others) necessitates the use of a weighed filter. The filter is first thoroughly dried in the water-bath, and usually allowed to cool between a pair of well-fitting

watch-glasses. In this manner, it is very difficult to get accurate results: though the watch-glasses may fit very perfectly, the weight of the filter will rapidly increase after being taken out of the exsiccator.

To more perfectly protect the filter from external moisture, the holder about to be described was substituted for the watch-glasses. A test-tube of about 18 m.m. diameter was cut off about 10 centimetres from the closed end. A second test-tube was then selected, which fitted tightly over the first. The latter was then melted at a convenient distance from the end, and closed, so as to form a small and almost air-tight cover for the first tube. A dry filter, held in the old manner, between watch-glasses, absorbed, in a few hours, 14 milligrammes; while a filter in the holder described, in the same position, and in the same time, had absorbed only 0·6 milligramme.

Twenty c.c. of the arsenious-acid solution were measured off into a small beaker, neutralised with excess of acid, and chlorine conducted into the solution to strong excess. Ammonia was then added, and the arsenic acid precipitated by the "magnesia mixture," and proceeded with precisely as described in Fresenius's "Quantitative Analysis." The filter and precipitate were dried for two or three hours, at a temperature of 110°.

	grms.
Holder + filter + precipitate weighed....	8·1970
Holder and filter.....	7·8892
Double arseniate.....	0·3078
Correction for filtrate (101 c.c.).....	0·0063
	0·3141
Equivalent to arsenious acid.....	0·1636

A result which is far too low.

Twenty c.c. were treated precisely as before, but with additional care, to ensure the complete oxidation of the As_2O_3 to As_2O_5. The precipitate was dried at 110° C. until the weight remained constant.

	grm.
The precipitate weighed.....	0·3095
Correction for filtrate (93 c.c.).....	0·0058
	0·3153

A result still very much too low.

A third quantity was measured off, and this time was oxidised by conducting chlorine gas into the alkaline solution without addition of hydrochloric acid.

	grm.
The weight of the precipitated arseniate (together with corrections for the filtrate) equalled.....	0·3244
Equivalent to arsenious oxide.....	0·1690

A result still too low.

Another portion was measured off, and proceeded with precisely as the last. The precipitate corresponded to 0·1670 grm. arsenious acid—a result still unsatisfactory.

The irregularity of these results led the author to conclude that either the correction for the filtrate is incorrect, or that the formula (AsO_4, Mg, NH_4), $2H_2O$ does not represent the composition of the compound after being dried at 100°—110° C. To discover if the former were the case, a filtrate from one of the previous estimations, measuring 76 c.c., was neutralised with hydrochloric acid, and treated at a gentle heat for some hours with a slow stream of sulphuretted hydrogen, until all the arsenic was completely precipitated. The precipitate was filtered off, washed, dried, treated with CS_2 to remove any free sulphur that might be present, and weighed. The weight equalled 0·0019 grm., corresponding to 0·0029 of the magnesia precipitate. The correction usually made (namely, 1 milligramme for every 16 c.c.) would indicate a larger quantity than this, namely, 0·0047 grm.; so that an error from this source would render the result too high, instead of, as the case is, too low.

To discover the composition of the magnesia precipitate after being dried at 110° C., the pure precipitate was prepared in the following manner:—A quantity of pure arsenious oxide was powdered, and treated with strong nitric acid, to convert it into arsenic acid. The acid liquid was neutralised with ammonia, diluted, and precipitated with a solution of magnesium sulphate, care being taken to avoid an excess of the latter. The precipitate was well washed, first by decantation, subsequently on a large filter, with pure distilled water, and then thoroughly dried over sulphuric acid. A portion of it (about 1 grm.), further dried for thirteen hours over sulphuric acid, lost 0·0002 grm.

1·6822 grm. was dried at a temperature of 100° C. for three hours. It lost 0·6319 grm. For two hours longer, it had lost 0·6329 grm. The total loss amounted to 37·62 per cent; theory would lead us to expect only 34·25.

0·6059 grm. was then dried in the water-bath, the temperature of which, however, was not much above 90° C.

	grm.		per cent.
After 12 hours it lost....	0·2020	=	33·34
" 18 " "	0·2036	=	33·59
" 24 " "	0·2054	=	33·80

No further decrease in weight took place.

1·0152 grms. were again heated in the air-bath.

	grm.		per cent.
4 hours at 100°—107° C. lost	0·3745	=	36·88
" " " 105°—110° " "	0·3867	=	38·10
3 " " 105°—110° " "	0·3927	=	38·60

All of which are much above the theoretical loss.

The next step was accurately to ascertain the composition of the precipitate, dried over sulphuric acid. For this purpose, 1·0894 grms. were dissolved in hydrochloric acid, the arsenic precipitated with sulphuretted hydrogen, and filtered off; the filtrate concentrated, neutralised with ammonia, and the magnesia thrown down in the usual manner as a phosphate. The magnesia found equalled 13·92 per cent; the salt should theoretically contain 13·84.

To estimate the amount of ammonia in the salt, 0·2656 grm. was distilled in a small flask with caustic potash, and the escaping ammonia collected in a measured quantity of standard sulphuric acid, the excess of which was subsequently estimated by a standard alkaline solution. The sample contained 8·92 per cent; the theoretical proportion is 8·95 per cent. From these two determinations, I concluded that the formula $PO_4,Mg,NH_4,6H_2O$ correctly represented its composition.

It is well known that the error caused by heating the sample too highly is due to ammonia which escapes. The next experiment was to discover at what temperature the ammonia commences to be evolved. About 2 grms. of the precipitate, in a small porcelain boat, were introduced into a glass tube, so arranged as to be heated by an air-bath to any desired temperature.

Air was drawn, by an aspirator, first through the tube, and then through a few cubic centimetres of pure water, slightly coloured with neutral litmus. The temperature had not been raised above 80° C., when ammonia manifested itself by changing the colour of the litmus. A weighed quantity was next operated upon, the tube being heated by a water-bath, and the escaping gases conducted through a small quantity of standard sulphuric acid. In about an hour, the sample had lost 5 per cent of ammonia. I therefore conclude that, at a temperature of about 90° C., ammonia escapes, but more than 1 equiv. of water is retained; while, at a temperature of from 100° to 110° C., this excess of water, and probably more ammonia, are driven off; and I therefore consider that no definite compound of arsenic can be obtained by drying the precipitate at a temperature at all suitable for a counterpoised filter. By heating the precipitate strongly to obtain AsO_4,Mg, arsenic invariably escapes. A plan was tried of first evaporating the precipitate with nitric acid before ignition, with a view to form ammonium nitrate, and prevent the reduction of the arsenic; but a loss still took place. Tolerably accurate results may be obtained by dissolving the precipitate in hydrochloric acid, precipitating the arsenic with sulphuretted hydrogen, and weighing it as As_2S_5. The salt, by this method, contained 25·78 per cent, instead of 25·90 per cent. This sulphide cannot be reduced to As_2S_3 by treatment with CS_2, which leads one to conclude that it is a penta-sulphide, and not, as some maintain, a mixture of As_2S_3 and free sulphur.

Estimation of Arsenious Oxide by Precipitation as Sulphide.

Twenty c.c. of the arsenious-acid solution were measured off, neutralised with hydrochloric acid, and the arsenic thrown down as tersulphide by sulphuretted hydrogen. The excess of the latter reagent was expelled by conducting carbonic acid into the liquid. The sulphide was collected on a tared filter, washed, and dried at 100° C. until the weight remained constant. The sulphide weighed 0·2114 grm., equivalent to 0·1701 grm. AsO_3.

Another 20 c.c. were treated in precisely the same manner. The sulphide weighed 0·2116 grm., equivalent to 0·1703 As_2O_3.

These two results agree together very closely, but are both slightly too low. Probably, if the precaution were taken to avoid a great excess of hydrochloric acid, still more accurate results might be obtained.

The only methods for estimating copper that were experimented on were the well-known plan of precipitating the metal as an oxide by means of a solution of caustic potash or soda, washing well with boiling water, igniting, and weighing; and the plan of igniting either the sulphide or the sulphocyanide with sulphur in a stream of hydrogen gas. The accuracy of the first method is so well established that it is not necessary to give details of experiments. The latter methods also give exceedingly accurate and constant results.

For estimating the amount of arsenic in ores, from the above experiments, I should imagine the neatest, simplest, and most accurate mode of procedure to be to heat the finely-divided sample, in a gentle stream of chlorine gas, to a temperature of about 200° C., and to collect the escaping arsenic-chloride in chlorine-water. If free from antimony, the liquid might be well boiled, to expel free chlorine, and the arsenic precipitated with sulphuretted hydrogen, and weighed as As_2S_5; or it might, perhaps, be better estimated by some volumetric method.

In cases where the arsenic is obtained in the form of $AsO_4,Mg,NH_4,6H_2O$ (as in separations of the metal from antimony or copper), the most accurate plan would be to dissolve the precipitate in hydrochloric acid, and precipitate the arsenic as As_2S_5. When the amount of arsenic is small, it might be weighed as the double arseniate. The sample should not, however, be dried at a higher temperature than that of any ordinary water-bath—namely, about 95° C. Perfectly accurate results could, no doubt, be obtained by drying the precipitate over sulphuric acid, when it retains its 6 equivs. of water. The only objection is that it would take days for a filter containing a precipitate to be properly dried by this means.

Runcorn, March 8th, 1870.

THE "WEAPON-SALVE" OF PARACELSUS.

BY G. F. RODWELL, F.C.S.

Among the more curious of the magical remedies of the sixteenth and seventeenth centuries was a certain ointment, invented by Paracelsus, which, he asserted, would cure all wounds resulting from violence, by being applied to the weapon which had caused the wound (or its facsimile), under certain precise and stringent conditions. The directions which are given for the preparation of this unguent vary slightly, according to different authors. It was to be compounded of moss from the skull of an unburied man, gathered under certain planetary conditions, of oil, "mummy," and human blood, while some recommended the addition of the "dryed brain of a wilde bore." The most minute directions were given for applying the unguent to the weapon, and a slight carelessness could as easily cause the death of the patient as his cure: thus it was said, "Beware that the weapon fall not downe, nor the winde blow upon it in a cold place, for it will force the patient to madness." Many writers wrote strongly in favour of this cure; among them, Crollius, Baptista Porta, Cardanus, Burgravius, and Coclinius. Lord Bacon alludes to it in his "Sylva Sylvarum" (cent. 10, par. 998), and adds, "though myself, as yet, am not fully inclined to believe it." Robert Fludd, a physician, and a contemporary of Bacon, was one of its staunch supporters.

Now, a certain William Foster, "M.A., and Parson of Hedgeley, in the County of Buckingham," who appears to have been fond of controversy, and dissatisfied with his position in the Church, was particularly bitter against this cure, which he verily believed to be the work of the devil. Full of this idea, he published a brochure of fifty-six pages, in 1631, entitled "Hoplocrisma Spongus; or a Sponge to wipe away the Weapon-Salve. A treatise wherein is proved that the cure late taken up amongst us, by applying the salve to the weapon, is magicall and unlawful." In the preface, Foster, in vindication of the violent attack which he made upon the advocates of this cure, says—"I dare call sin, sin in whomsoever. If Jesabell be painted, with Jehu I will not have peace with her to commend her, though a queene. If Herod be incestuous, with the Baptist I'll not sooth him, though a king. If Simon Magus be a sorcerer, I feare not his divell; with S. Peter, I'll rouze him, though a witch. Shall anyone, for my boldnesse, think to sit upon my skirts? Let these

knowe I esteeme myself *infra invidiam.* I cannot have lesse in the Church, unlesse nothing. And, if they shall endeavour to keep me still low, let them knowe I looke for no good from them that envie my endeavours to do good." Against Fludd, as one of the most recent advocates of the cure, Foster is specially virulent; indeed, the brochure is principally directed at him. At first, Fludd took no notice of the attack, deeming Foster, as he tells us, not worthy of notice; but, finding one morning that Foster had caused a title-page of the "Hoplocrisma Spongus" to be nailed to each of his door-posts, he was so incensed thereby that he forthwith brought out a brochure of 212 pages in reply. It is entitled—"The Squeezing of Parson Foster's Sponge, ordained by him for the wiping away of the Weapon-Salve. Wherein the sponge-bearer's immodest carriage and behaviour towards his brethren is detected; the bitter flames of his slanderous reports are, by the sharpe vineger of truth, corrected and quite extinguished; and, lastly, the vertuous validity of the sponge in wiping away of the weapon-salve is crushed out, and thus abolished." On the title-page, Fludd introduces a verse from the 92nd Psalm concerning the fall of the wicked man, and also the somewhat pointed remark—"Opera Dei, vir brutus et stultus, non intelligit." It is to be confessed, however, that he was a good deal provoked. The manner in which the controversy was continued is somewhat amusing, when we remember the subject of it. Foster, after mentioning several men who had advocated the weapon-salve, and indirectly including Fludd amongst them, says—"I wonder at nothing more than that Beelzebub was not in the number." To which Fludd replies—"A singular diabolical conceit . . . . . Marry, I will tell him why:—If it had been true that the use of the weapon-salve is witchcraft, and the users thereof witches and conjurers (as he boldly saith), how, I pray you, should Beelzebub be missing from our company? . . . And this is the reason that Mr. Foster and his like have failed to find Beelzebub or the Devil in this number, forasmuch as he is nearer to them than they are aware of."

After vindicating himself, and disavowing all connection with magic and necromancy, Fludd attacks certain of Foster's statements in regard to other matters. "I will proceed now," he says, "to the greatest assault, wherein his sponge rubbeth very hard against my text, but prevaileth no more than they which go about to wash away the colour of a black-moore." He then enters into an elaborate statement to prove that "devils have aëry bodies allotted to them in their creation," which Foster had denied. And thus is the foolish controversy continued to the end. The amount of erudition brought to bear upon it is surprising, and worthy of a better theme. An assertion is rarely made on either side without a quotation to back it up, Foster preferring the Fathers of the Church (notably SS. Augustine and Jerome), while Fludd goes back to the ancient Greeks, and to Hermes Trismegistus. They both quote the Scriptures profusely, Foster because he is a clergyman, Fludd because he knows that arguments drawn from that source will most prevail with a Churchman.

We do not hear much more of the weapon-salve. After all, it is scarcely more absurd than some of the beliefs which prevail in the present day in remote country districts—such, for instance, as the cure of warts by rubbing them with a piece of stolen meat. The belief in cures of this nature was rife in the seventeenth century. Bacon asserts many of them. We must remember that the belief in witches and demons, spells, conjurations, philtres, and raisings of the devil, was as firm then amongst all classes of Society as it is now in many a lone hamlet in Cornwall, and many a green village of Galway or of Wales. Of necessity, superstition lingers longest in those places which are most removed from centres of thought and civilisation. There is a conservative attitude of idea about people who are much shut out from the external world. We know a village not two hundred miles from London (which there is no reason to believe differs from other villages distant from large towns) in which there are many Middle-Age superstitions; there is a witch, moreover, who possesses the power of the evil-eye, and those who offend her are sure to suffer, sooner or later, some dire calamity; we have not yet heard of her raising a familiar demon. Now, all this goes on in a village by no means debarred from the progress of civilisation; there is a boys' school with a certificated master, a girls' school with a certificated mistress, a night-school, a Sunday-school, penny-readings, and occasional concerts, not to speak of a really good village-library. If, then, in this nineteenth century, all manner of rank superstitions are among us (and we have most of us some pet superstition or other), we can scarcely cry shame on the advocates of the weapon-salve two centuries and a half ago. As for Parson Foster, of Hedgeley, he was certainly a man born out of due time.

QUICK WET ASSAY OF GALENA AND OTHER COMPOUNDS OF LEAD.*

BY FRANK H. STORER,

PROFESSOR OF CHEMISTRY IN THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

When in contact with metallic zinc, galena is readily decomposed by acids. Even oxalic, acetic, and dilute sulphuric acids are capable, when hot, of decomposing galena,—metallic lead being deposited and sulphuretted hydrogen gas set free,—while with chlorhydric acid the decomposition is peculiarly rapid and complete.

Galena is easily decomposed, also, even in the cold by dilute nitric acid in presence of zinc; but the reaction differs in this case from that just described—not metallic lead but free sulphur is deposited, while nitrate of lead goes into solution.

The reaction with zinc and chlorhydric acid may be employed with advantage for assaying galena, particularly the common American variety, which contains no other heavy metal besides lead. The details of the process are as follows:—Weigh out 2 or 3 grms., or more, of the finely powdered galena. Place the powder in a tall beaker, together with a smooth lump of pure metallic zinc. Pour upon the mixed mineral and metal 100 or 150 c.c. of dilute chlorhydric acid which has been previously warmed to 40° or 50° C.; cover the beaker with a watch glass or broad funnel, and put it in a moderately warm place.

Chlorhydric acid, fit for the purpose, may be prepared by diluting 1 volume of the ordinary commercial acid with 4 volumes of water. For the quantity of galena above indicated, the lumps of zinc should be about an inch in diameter by a quarter of an inch thick; they may be readily obtained by dropping melted zinc upon a smooth surface of wood or metal.

The zinc and acid should be allowed to act upon the

* Communicated by the Author.

mineral during fifteen or twenty minutes in order to ensure complete decomposition. Any particles of galena which may be thrown up against the cover or sides of the beaker should, of course, be washed back into the liquid. It is well, moreover, to stir the mixture from time to time with a glass rod.

When all the galena has been decomposed, as may be determined by the facts that the liquid has become clear, and that no more sulphuretted hydrogen is evolved, decant the liquid from the beaker into a tolerably large filter of smooth paper, in which a small piece of metallic zinc has been placed. Wash the lead and zinc in the beaker as quickly as possible with hot water, by decantation, until the liquid from the filter ceases to give an acid reaction with litmus paper; then transfer the lead from the beaker to a weighed porcelain crucible. In order to remove any portions of lead which adhere to the lump of zinc, the latter may be rubbed gently with a glass rod, and afterwards with the finger or a piece of caoutchouc, if need be. Wash out the filter into an evaporating dish, remove the fragment of zinc, and add the particles of lead thus collected to the contents of the crucible. Finally, dry the lead at a moderate heat in a current of ordinary illuminating gas, and weigh.

The lead may be conveniently dried by placing the crucible which contains it in a small cylindrical air-battery of Rammelsberg's pattern, provided with inlet and outlet tubes of glass, reaching almost to the bottom of the bath.

When the process is conducted as above described, the lead undergoes no oxidation; hence there is no occasion for igniting the precipitate in a reducing gas. The precipitate needs only to be dried out of contact with the air.

If desirable, the sulphur in the galena could be determined at the same time as the lead, by arresting the sulphuretted hydrogen in the ordinary way.

If the mineral to be analysed is contaminated with a siliceous or other insoluble gangue, the metallic lead may be dissolved in dilute nitric acid, after weighing, and the insoluble contamination collected and weighed by itself. In the case of galenas which contain silver, antimony, copper, or other metals, precipitable by zinc, the proportion of each metal must be determined by assay or analysis in the usual way after the total weight of the precipitated metals has been taken.

Besides galena, almost any of the ordinary lead compounds may evidently be assayed by the method above described. I find, for example, that metallic lead may be precipitated quickly and completely from the sulphate, chromate, nitrate, oxide, and carbonate—and with peculiar ease from the chloride—by means of zinc and chlorhydric acid. The method would furnish an easy qualitative test for the detection of barytes in white lead. When applied to the analysis of nitrate of lead, it would probably be best to decompose the nitrate by means of a solution of chloride of sodium before adding the zinc and chlorhydric acid.

In all these cases the decomposition of the lead salt by the zinc is so complete, that no trace of colouration is produced when sulphuretted hydrogen is added to the liquid decanted from the metallic lead.

The following determinations of lead in a sample of pure galena from Galena, Illinois, were made in the manner above described by my assistant, Mr. A. H. Pearson:—

	Grammes of galena taken.	Grammes of lead found.	Per cent of lead found.	Theory.
No. 1.	1·4847	1·2908	86·93	86·62
" 2.	0·5902	0·5120	86·75	
" 3.	3·6320	3·1568	86·91	

Attempts to determine sulphur and lead in the same portion of galena, by means of the reaction of zinc and dilute nitric acid, above described, gave no satisfactory results. The free sulphur obtained by treating galena with zinc and ordinary nitric acid, diluted with 3, 4 and 5 volumes of water, always retained a small quantity of lead, while a certain amount of sulphuric acid was found in the clear liquid. It is, in short, well nigh, or quite, impossible to avoid the secondary reactions between zinc and nitrate of lead, and between sulphur and nitric acid which set in as soon as, or just before, the last traces of the galena have been decomposed.

Boston, Feb., 1870.

ON THE ESTIMATION OF AMMONIA IN ATMOSPHERIC AIR.*

BY HORACE T. BROWN.

In the attempts that have been hitherto made to estimate the ammonia present in atmospheric air, the results arrived at by the various experimenters have differed so widely that it is still a matter of uncertainty what the quantity really is. That it is a very small amount all agree, but the extreme results on record vary as much as from 13·5 to 0·01 part of carbonate of ammonium per 100,000 of air. It may, therefore, not be without interest to give an account of a simple method affording very concordant and, I believe, accurate results; at the same time being easy of performance and requiring but little time for an experiment.

The apparatus used consists of two glass tubes, each of about 1 metre in length and 12 m.m. bore. These are connected air-tight by means of a smaller glass tube, and inclined at an angle of 5° or 6° with the horizon. Into each of the larger tubes are introduced 100 c.c. of a mixture of perfectly pure water and two drops of dilute sulphuric acid (sp. gr. 1·18). Through this acidulated water a measured quantity of the air under examination is slowly drawn, in small bubbles, by means of an aspirator.

No porous substance must be used to filter the air, for reasons to be stated hereafter. The air is conducted into the absorption liquid through a small piece of quill tubing drawn out to a small aperture at the end, immersed. This tube must be kept quite dry throughout the experiment. Great care must be taken to cleanse perfectly every part of the apparatus with water free from ammonia, and the caoutchouc plugs, or corks, used must be boiled for a short time in a dilute solution of caustic soda.

The stream of air is so regulated as to allow about 1 litre to pass through the apparatus in an hour.

By directing the point of the delivery-tube laterally, each bubble has imparted to it on rising an oscillatory movement, which facilitates complete absorption of the ammonia.

When from 10 to 20 litres of air have passed, the liquid is emptied from the tubes into upright glass cylinders, an excess of a perfectly pure solution of potash added, and then 3 c.c. of a Nessler solution. The standard of comparison is made in the ordinary way, only using acidulated in place of pure water, and neu-

* A paper read before the Royal Society, March 17, 1870.

[English Edition, Vol. XXI., No. 539, pages 137, 138.]

tralising with potash after adding the standard solution of ammonium salt. Beyond somewhat retarding the point of maximum colouration, a little potassium sulphate does not interfere with the delicacy of Nessler's reaction.

If the experiment has been conducted with proper care, at least four-fifths of the total ammonia ought to be found in the first tube. Four or five litres of air are generally quite sufficient to give a decided reaction, but it is better to use not less than 10 litres, as before mentioned.*

Very many experiments have been made by this method, both on air from the town of Burton-on-Trent, and that of the adjoining country. The air from the town, as might be expected, varies somewhat in composition; much more so than that taken from the open country, as may be seen from the following tables, in which are given some of the numerous results obtained.

The ammonia is calculated in every case as carbonate [$(NH_4)_2CO_3$]; for although nitric acid is sometimes found in air, yet its presence must be looked upon as accidental.

In the immediate vicinity of towns, some of the ammonia must also be in the form of sulphate, sulphite, or ammonium chloride.

(1). *Air taken from town.* (Taken at a height of 2 metres from ground.)

Date of Experiment.	$(NH_4)_2CO_3$ as grammes per 100,000 litres of air at 0° C. and 760 m.m. barom.	$(NH_4)_2CO_3$ in parts by weight per 100,000 of air.
1869. Sept. 30	1·12940	0·8732
Oct. 4	0·62117	0·4801
" 6	0·52510	0·4059
" 8	0·62117	0·4801
Nov. 26	1·07290	0·8293
" 28	1·10000	0·8503

(2). *Air from country.* (Taken at a height of 2 metres.)

Date of Experiment.	$(NH_4)_2CO_3$ as grammes per 100,000 litres of air at 0° C. and 760 m.m. barom.	$(NH_4)_2CO_3$ in parts per 100,000 of air.
1869. Dec. 6	0·7620	0·5890
" 8	0·7826	0·6085
" 9	0·6601	0·5102
" 11	0·6635	0·5121
1870. Feb. 12.	0·7639	0·5904

The direction of the wind does not seem to have any influence on the ammonia found; immediately after heavy rain, however, the quantity falls somewhat below the average, but the air is again restored to its normal condition after a lapse of two or three hours.

Attempts were made to make the method more delicate still by absorbing the ammonia in pure water and then distilling, but the nitrogenous organic matter suspended in the air was found to interfere with the results.

When the air is passed through cotton-wool before entering the absorption-tubes, it is found to be entirely deprived of its ammonia by the filter. This is also the case with air artificially charged with ammonia *to a large extent.* This absorption is not due to the presence of hygroscopic moisture, since cotton-wool, when absolutely dry, is capable of taking up 115 *times its own bulk* of dry ammonia (confined over mercury) at 10·5° C. and 755·7 millims. barom.; the gas being again slowly evolved when the wool is left in contact with the air at 100° C.

All other porous substances that were tried for filtering agents were found to possess this property more or less; even freshly ignited pumice-stone is not entirely without absorptive effect upon the gas.

* When the air to be examined is highly charged with ammonia, as that from stables, &c., a perfectly dry bottle of 3 or 4 litres capacity should be carefully filled with a pair of bellows, 100 c.c. of acidulated water introduced, and, after closing securely, the whole well agitated at intervals for three or four hours. The liquid is then poured out, and the NH_3 estimated by the Nessler solution as usual.

REPORTS OF SOCIETIES.

CHEMICAL SOCIETY.

February 17th, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The following gentlemen were elected Fellows:—R. T. Atcherley, T. W. Axe, A. H. Bateman, E. Francis, A. Prangley, W. Pritchard, L. B. Ross, T. G. Rylands, T. Wills, P. Wright.

An account was given by Professor Tyndall of his researches on "*The Action of Light on Gases and Vapours*," illustrated by a series of beautiful experiments.

Dr. Tyndall began by remarking that it had, for the last ten years, been his endeavour to make radiant heat a means of getting an insight into the working of the atomic forces, or, in other words, into the state which is called chemical combination. Whilst pursuing his experiments with luminous waves on matter in a finely divided state, he was forced to imagine molecules and atoms; indeed, his belief in the existence of atoms is founded more upon those physical evidences than upon the considerations which are current in the chemical world. If he had to give up the notion of atoms, and to replace that conception by the abstract idea of multiple proportions, he would feel completely at a loss how to account for changes in the physical properties of matter. After these introductory remarks, the lecturer proceeded to the main subject. The apparatus which served to illustrate the statements consisted of a glass tube, about 3 feet in length and about 3 inches internal diameter, closed at each end by glass discs. This tube, after having been exhausted by an air-pump, was partly filled with dry air which had been permitted to bubble through the liquid whose vapours were to be examined. The condensed beam of an electric lamp was now caused to pass through the tube from end to end.

Since the aim of these experiments is to render visible the chemical action of light upon vapours, substances have been chosen, one, at least, of whose products of decomposition by light has so high a boiling point that, as soon as it is formed, it is precipitated. Nitrous oxide gas, the vapours of amylic iodide, amylic nitrate, benzol, &c., mixed with some air which had passed through hydric nitrate or hydric chloride, were found well suited for this purpose. In all cases, no matter what the nature of the vapour was, if only employed in a sufficiently attenuated state, the visible action commenced with the formation of a blue cloud, which, in some instances, was of the deepest azure tinge, rivalling the colour of the purest Italian sky. When a cell containing some of the liquid whose vapours were to be examined was inserted between the lamp and the tube, no clouds were formed within the tube—the luminous waves traversing the liquid had been deprived of their acting power. When polarised light was sent through the tube, the blue cloud was visible only in one direction, the direction varying according to the position of the Nicol prism. When the short diagonal of the Nicol was vertical, the blue cloud was seen when the spectator's eye looked horizontally upon the tube, not otherwise. As soon as the prism was turned round its axis, the blue cloud was only seen when the line of vision fell vertically upon the experimental tube.

After concluding this account of this highly interesting

subject, Professor Tyndall showed some of the experiments bearing on his researches upon Dust, quite recently communicated at the Royal Institution

The next meeting of the Society will take place on March 3rd, when Dr. Gladstone will deliver a lecture on "Indices of Refraction."

March 3rd, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

Mr. C. P. Sandberg, of Stockholm, was elected a Fellow of the Society.

The first paper was by Dr. Gladstone, on "*Refraction Equivalents.*"

Three distinct lines of research had led up to the discovery of these equivalents. The first was the influence of temperature on the refraction of light by liquids; the second, the refraction of mixtures or combinations as compared with that of their constituents; and the third, the refractive indices of different members of homologous series of organic compounds. As to the first of these, it was found, by the joint labours of Dr. Gladstone and the Rev. Pelham Dale, that the refraction and the dispersion decrease as the temperature rises. Further examination showed a close relation between the change of density and the change of the refractive index minus unity, which the experimenters termed the "refractive energy," and which is expressed in the language as $u - 1$. This energy, divided by the density, that is,

$$\frac{u-1}{d}$$

is called the "specific refractive energy," and is, in the case of liquids, a constant, not affected by temperature. This conclusion was subsequently confirmed by the experiments of Landolt, Wüllner, and Kühlmann. As to the second line of research (that of the refraction of mixtures, solutions, and simple combinations), Dulong attempted to show in regard to gases, and Hock in regard to some liquids, that the refractive power of a mixture is the mean of the refractive powers of its constituents. But Gladstone and Dale arrived at the conclusion that here, also, the nearest approximation to the truth was given by

$$\frac{u-1}{d};$$

and their opinion has been fully confirmed by the careful experiments of Wüllner. This general expression holds good, also, in the case of a gas or a solid in solution; and, indeed, it was expected to be so, for water, phosphorus, and sulphur have the same energies in the liquid and solid states. The question now presented itself—Does an elementary substance retain its specific power of retarding rays when it is combined chemically with other elements? An affirmative reply was suggested by many considerations. It was, for instance, found that bromoform ($CHBr_3$) and bibromide of bromethylene ($C_2H_3Br_3$) have almost the same specific refractive energy as bromine itself.

On the other hand, however, the investigators observed that isomeric liquids were not always identical in refractive energy; and that the replacement of hydrogen by oxygen in organic compounds effected a much greater optical change in some instances than in others. Hence the conclusion was drawn that the specific refractive energy of every liquid is composed of the specific refractive energies of its component elements, modified by the manner of combination.

The third line of research was that of the refractions of different homologous compounds. The experiments of Delffs, of Landolt, and of Gladstone and Dale, have led to the view that, in all the series containing the radicles, methyl and its congeners, the specific refractive energies increase as the series advances, and that the amount of optical change is less between the higher than between the lower members of the series. Landolt, adopting Gladstone and Dale's formula for the specific refractive energy, multiplied it by the atomic weight P; and this

$$P\,\frac{u-1}{d}$$

he designated the "refraction-equivalent." According to this representation, the refraction-equivalent of a body is the sum of the refraction-equivalents of its constituent elements. The great advantage of this kind of expression is that it permits of the easy comparison of the optical properties of different substances. By making these comparisons, Landolt found that the refraction-equivalent of carbon is 5·0; that of hydrogen 1·3; and that of oxygen, 3·0. Direct experiments have given figures very close to these. The way of calculating the refraction-equivalent of a compound from these data may be illustrated by ether, $C_4H_{10}O = 4(5{\cdot}0) + 10(1{\cdot}3) + 3{\cdot}0 = 36{\cdot}0$. The refraction-equivalent deduced from observation is 36·26. A great variety of liquids have given, by calculation, the same figures for the refraction-equivalents as by direct investigation. Yet there are exceptions to this agreement with theory. The whole group of the aromatic hydrocarbons and their derivatives give refraction-equivalents much above the calculated numbers. This anomaly must be due to an erroneous representation of the constitution of their nucleus, which cannot be greater than C_6H_3. However, the above method makes it possible to find the refraction-equivalents of bodies which could not otherwise be taken—for instance, of metals. The refraction-equivalents of fifty elements have been determined in this way.

It is to be remarked that the figures in the following list, which gives the refraction-values of the more important elements, represent A of the solar spectrum:—

Aluminium...	8·4	Manganese...	12·2—26·2
Barium.....	15·8	Mercury.....	21·3—29·0
Bromine.....	15·3—16·9	Nitrogen....	4·1— 5·3
Calcium.....	10·4	Oxygen.....	2·9
Carbon.....	5·0	Phosphorus..	18·3
Chlorine.....	9·9—10·7	Platinum ...	26·0
Chromium...	15·9—23·0	Potassium...	8·1
Copper.....	11·6	Silicon.....	7·5— 6·8
Hydrogen....	1·3— 3·5	Silver.....	13·5
Iodine.....	24·5—27·2	Sodium.....	4·8
Iron.....	12·0—20·1	Sulphur.....	16·0
Lead.....	24·8	Tin.....	27·0—19·2
Magnesium...	7·0	Zinc.....	10·2

It will be seen that some of the elements have a double value; and this peculiarity is, in most cases, coincident with a change of atomicity. Thus iron, in the ferrous salts, has the equivalent 12·0; in the ferric salts 20·1 and, since the refraction-equivalent of iron in potassic ferridcyanide is 11·7, the view suggests itself that the metal is here in the same condition as in the ferrous salts. Great anomalies present themselves in the case of oxygen. Its equivalent, in many compounds, is 2·9; but, in others, it comes down to 2·1; and, in some cases, as in some sulphates and phosphates, it would seem to be a negative quantity. This points to the conclusion that oxygen has the power of greatly modifying the action on light of those bodies with which it is combined in a high proportion.

On looking over the above list, one is struck by the identity of the equivalents of those elements which have the same, or nearly the same, atomic weight. This property is still more prominent when the specific refractive energies of the elements, instead of their refraction-equivalents, are considered. The following pairs may serve as illustration:—

Iron.....	0·214	Aluminium	0·307	Bromine	0·191
Manganese	0·222	Chromium	0·305	Iodine..	0·193

But the most suggestive comparison is that between the specific refractive energy and the combining proportions of

those metals that form salts not decomposable by water. By combining proportion is meant the actual amount which will combine with a certain quantity of a salt radicle. A few of these metals may be quoted:—

	Specific refractive energy.	Combining proportion.
Hydrogen	1300	1
Aluminium	307	9·1
Calcium	260	20
Iron	214	28
Sodium	209	23
Potassium	207	39·1
Copper	183	31·7
Silver	125	108
Lead	120	103·5
	&c.	

The regularity in the decrease of the numbers in the first column, and the corresponding increase in the second column, would suggest that the combining proportions of silver, lead, &c., ought to be halved, in order to bring those elements to about their right places in the list. There is, further, a remarkable coincidence between the power of a metallic element to refract the rays of light and its power to saturate the affinities of other bodies (of course, it must be borne in mind that a small combining proportion means a high saturating power).

Dr. Thudichum made a communication "*OnK ryptophanic Acid*," a normal ingredient of human urine.

The substance can be obtained in various ways from the primary material. One is to treat the urine with an excess of milk of lime to concentrate the mixture, filter it from the gypsum to acidify the filtrate, and evaporate it to syrupy consistency. This syrup, after having been filtered from the salt-cake, is treated with strong alcohol, which separates the lime-salt of the kryptophanic acid as a dark, flaky mass. The impure lime-salt is dissolved in water, and mixed with a solution of neutral lead-acetate: a dark-coloured precipitate is formed, from which the mother liquor is filtered. The filtrate, containing lead-kryptophanate, is treated with strong alcohol, whereupon white lead-kryptophanate is deposited in flakes, from which the acid is liberated by sulphuretted hydrogen.

Kryptophanic acid is an amorphous, gummy mass, transparent, and nearly colourless. It forms salts with the alkalies, the alkaline earths, and many metals. In the aqueous solutions of its earthy salts, a precipitate is produced by mercuric nitrate (the ordinary analysis for urea by this reagent is thus shown to be liable to error). The determinations of the free acid, as well as of its salts, have led to the formula $C_5H_9NO_5$, and shown the acid to be dibasic; in some cases, however, it may be taken as tetrabasic, and then its formula would be $C_{10}H_{18}N_2O_{10}$.

For the next meeting, on March 17th, the following papers are announced:—"On Artificial Alizarine," by W. H. Perkin, F.R.S.; and, "On the Combinations of Carbonic Acid with Ammonia and Water," by Dr. Divers.

March 17th, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The following gentlemen were elected fellows:—D. Brown, A. Muirhead, T. L. Patterson, D. Penny, S. T. Smith.

The first paper read was "*On Artificial Alizarine*," by W. H. Perkin, F.R.S.

Alizarine was first obtained from madder in a crystalline state by Robiquet and Colin. Their method of preparation (viz., sublimation) rendered it, however, a matter of doubt whether alizarine existed as such in the madder, or was a product of decomposition of some other body. Dr. Schunk, having succeeded in obtaining alizarine-crystals without taking recourse to sublimation, proved the first view. He gave it the formula $C_{14}H_{10}O_4$; whilst Strecker believed it to be $C_{10}H_6O_3$, relating it to Laurent's chloroxynaphthalic acid, since both these substances yield phthalic acid on treatment with hydric nitrate; in fact, chloroxynaphthalic acid was regarded as chlorinated alizarine—

$\underbrace{C_{10}H_6O_3}$. — Alizarine, or oxynaphthalic acid.

$\underbrace{C_{10}H_5ClO_3}$. — Chlorinated alizarine, or chloroxynaphthalic acid.

About five years since, Martius and Griess, when investigating the amido-derivatives of naphthol, obtained a colouring-matter possessing Strecker's formula; yet it was not alizarine, but a body isomeric with it. Some time after the discovery of this supposed isomer of alizarine, Graebe commenced his researches on quinone. This substance, obtained, as early as 1838, by Woskressensky as a product of the oxidation of quinic acid, was regarded by Kekulé as containing two molecules of carbonyl—$CO = C_4H_4 = CO$. But Graebe, induced by the results he had gained in his investigations of the quinone compounds, viewed it as a substitution-product of benzol, two of whose hydrogen-atoms are replaced by the group $[O - O]''$, in which half of the combining-values of oxygen saturate each other—

$\underbrace{C_6H_6}$ — Benzol.

$\underbrace{C_6H_4(O_2)''}$. — Quinone.

The best-known derivative of quinone is chloranil, or perchloroquinone, which is obtained by heating phenol with potassic chlorate and hydric chloride. When this body, $C_6Cl_4(O_2)''$, is heated with alkalies, potassic chloranilate, or dichloroquinonate, is formed. According to this reaction, Graebe regarded Laurent's chloride of chloroxynaphthyl as the dichlorinated quinone of naphthaline—

$\underbrace{C_{10}H_8}$ — Naphthaline.

$\underbrace{C_{10}H_4Cl_2(O_2)''}$ — Chloride of chloroxynaphthyl, or dichlornaphthoquinone.

When this naphthaline derivative is heated with alkalies, it behaves like chloranil; but, whilst, in the latter compound, two atoms of chlorine are removed, only one chlorine-atom is displaced in the case of the naphthaline derivative—

$$\underbrace{C_{10}H_4Cl_2(O_2)''}_{\text{Dichlornaphthoquinone.}} + 2KOH = \underbrace{C_{10}H_4Cl\left\{\begin{matrix}(O_2)''\\KO\end{matrix}\right.}_{\text{Potassic chloroxynaphthalate.}} + KCl + H_2O.$$

$$C_{10}H_4Cl\left\{\begin{matrix}(O_2)''\\KO\end{matrix}\right. + HCl = \underbrace{C_{10}H_4Cl\left\{\begin{matrix}(O_2)''\\HO\end{matrix}\right.}_{\text{Chloroxynaphthalic acid.}} + KCl.$$

Chlorinated quinones of toluol were obtained by Graebe and Burgmann, by heating cresylic acid with potassic chlorate and hydric chloride—

$\underbrace{C_6\left\{\begin{matrix}CH_3\\(O_2)''\\Cl_3\end{matrix}\right.}$ — Trichlortoluquinone.

$\underbrace{C_6\left\{\begin{matrix}CH_3\\(O_2)''\\Cl_2\\H\end{matrix}\right.}$ — Dichlorotoluquinone.

After it had been shown that chloroxynaphthalic acid was a quinone-acid, Graebe and Liebermann thought it probable that alizarine belonged to the quinone series. To gain some information about the hydrocarbon to which alizarine is related, they heated a specimen of the natural colouring-matter with powdered zinc, according to Baeyer's method of reducing aromatic compounds; and they obtained a substance of the composition $C_{14}H_{10}$. This hydrocarbon formed, with picric acid, a red compound, and, in fact, possessed all the properties of anthracene as obtained from coal-tar.

This discovery led Graebe and Liebermann to assume alizarine to be the quinone-acid of anthracene—

$\underbrace{C_{14}H_{10}}_{\text{Anthracene.}}$ $\underbrace{C_{14}H_8(O_2)''}_{\text{Anthraquinone.}}$ $\underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\HO\\HO\end{matrix}\right.}_{\text{Anthraquinonic acid or alizarine.}}$

Having obtained anthracene from alizarine, it now remained to produce alizarine from anthracene. Many years ago Laurente had obtained an oxygenated derivative of anthracene of the composition $C_{14}H_8O_2$. Graebe and Liebermann at once recognised this as the quinone of anthracene, and now it remained for them only to transform this anthraquinone into the acid by replacing two atoms of hydrogen by two of hydroxyl. For this purpose they heated anthraquinone with bromine, whereby dibrom-anthraquinone was obtained—

$$C_{14}H_8(O_2)'' + 4Br = C_{14}H_6\left\{\begin{matrix}(O_2)''\\Br_2\end{matrix}\right. + 2BrH.$$

On treating this with potassic hydrate at a temperature of about 180° C., the potassium salt of alizarine was obtained, from which the alizarine was liberated by hydric chloride—

$$\underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\Br_2\end{matrix}\right.}_{\text{Dibromanthraquinone.}} + 4KOH = \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\(KO)_2\end{matrix}\right.}_{\text{Potassic alizarate.}} + 2KBr + 2H_2O.$$

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\(KO)_2\end{matrix}\right. + 2HCl = \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\(HO)_2\end{matrix}\right.}_{\text{Alizarine.}} + 2KCl.$$

By thus producing alizarine from anthracene, Graebe and Liebermann have given the first instance of the artificial formation of a vegetable colouring matter.

But to turn this beautiful discovery to practical account, to render alizarine from anthracene a substitute for madder, it was necessary to replace the bromine required in the process by some cheaper reagent. It is known that hydric sulphate forms with many organic bodies compounds called sulpho-acids. According to the experiments of Wurtz and of Kekulé these compounds are acid sulphites.

$\underbrace{C_6H_6SO_3}_{\text{Sulpho-benzolic acid.}} = \underbrace{C_6H_5.HSO_3}_{\text{Phenyl-sulphurous acid.}}$

$\underbrace{C_{10}H_6(SO_3)_2}_{\text{Disulpho-naphthalic acid.}} = \underbrace{C_{10}H_6\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right.}_{\text{Naphthaline disulphurous acid.}}$

for, when heating sulpho-benzolic acid with potash they obtained a carbolate, and a sulphite—

$$C_6H_5.HSO_3 + 3KOH = C_6H_6KO + K_2SO_3 + 2H_2O.$$

Disulpho-naphthalic acid yields, by similar treatment, a naphthalenate and a sulphite—

$$C_{10}H_6\left\{\begin{matrix}HSO_3\\HSO_3\end{matrix}\right\} + 6KOH =$$

$$= \underbrace{C_{10}H_6\left\{\begin{matrix}KO\\KO\end{matrix}\right\}}_{\text{Potassic naphthalate.}} + 2K_2SO_3 + 4H_2O.$$

This potassic naphthalate can, by addition of an acid, be transformed into hydric naphthalate,

$$C_{10}H_6\left\{\begin{matrix}HO\\HO\end{matrix}\right.$$

which body stands to naphthaline in the same relation as alizarine to anthraquinone.

It appeared therefore probable that if a disulpho-acid of anthraquinone could be found, the formation of alizarine by a similar process may be rendered possible.

The formation of this sulpho-acid seemed, at first, not very probable, on account of the remarkable stability of anthraquinone, but on strongly heating it with hydric sulphate a sulpho-acid was at last obtained, which, on analysis, was found to be the desired disulphoanthraquinonic acid—

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\HSO_3\\HSO_3\end{matrix}\right.$$

This compound, heated with potassic hydrate to about 180° yields sulphite and alizarate of potash—

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\HSO_3\\HSO_3\end{matrix}\right\} + 6KHO =$$

$$= \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\KO\\KO\end{matrix}\right\}}_{\text{Potassic alizarate.}} + 2K_2SO_3 + 4H_2O.$$

from which potash salt the alizarine is thrown down by acids, just as brightly coloured and as pure as the alizarine from dibromanthraquinone.

It is, however, to be remarked that alizarine is not the primary product of the reaction of potash on the sulpho-acid, an intermediate body being first produced, which may be called sulphoxanthraquinonic acid, and the formation of which may be thus expressed:—

$$C_{14}H_6\left\{\begin{matrix}(O_2)''\\HSO_3\\HSO_3\end{matrix}\right\} + 4KOH =$$

$$= \underbrace{C_{14}H_6\left\{\begin{matrix}(O_2)''\\KO\\HSO_3\end{matrix}\right\}}_{\text{Potassic sulphoxanthraquinonic acid.}} + K_2SO_3 + 3H_2O.$$

This intermediate body is crystalline, of a yellow or orange colour, easily soluble in water, produces, with caustic alkalies, violet or blue solutions, and when heated with potassic hydrate yields alizarine and sulphurous acid.

The process just described may be modified by first forming a disulpho-acid of anthracene, and then converting this by means of oxidising agents into the disulphoanthraquinonic acid.

In the conversion of disulphoanthraquinonic acid into alizarine by the action of potassic hydrate, a peculiar reverse action takes place to some extent, both anthraquinone and anthracene being formed.

Artificial alizarines entirely identical with the colouring matter obtained from the madder root. Both of the products crystallise in needles, which are usually curved, especially when small. They dissolve in caustic alkalies, forming violet solutions of the same tint. When applied to mordanted fabrics they produce exactly the same colours, bearing the treatment with soap equally. They also possess precisely the same tinctorial value. The colours produced on fabrics by the artificial alizarine are as fast against light as those of madder. Cupric acetate produces in their alcoholic solutions a purple colouration. Their alkaline solutions show identical absorption bands in the spectrum. Both yield phthalic acid when treated with hydric nitrate.

It may be observed that a solution of sulphoxanthraquinonic acid in alcoholic potash has a very similar spectrum as an analogous alizarinic solution; but the spectra of the respective aqueous solutions are quite different.

As a substitute for madder artificial alizarine has been objected to, on the ground that pure alizarine alone will not produce the madder colours, other colouring matters being required. But Schunck says that, after a long course of experiments, he has been led to the conclusion, that the

final result of dyeing with madder is simply the combination of alizarine with the various mordants employed, and he recommends extraction from madder prints as the easiest method of preparing pure alizarine on a small scale. Mr. Perkin, on experimenting in this direction, could find nothing but alizarine on finished madder print. There is a second colouring matter in the madder root, the purpurine, but this cannot be found in the colour of the prints; if a mere trace of it were present it could easily be detected by its characteristic spectrum. It cannot be affirmed that purpurine never exists on prints dyed with madder or garancin, but it is certain that the higher the class of print, and, consequently, the more brilliant the colours, the purer is the alizarine in combination with the mordants.

Artificial alizarine as sent to the dyer and printer is not exactly pure alizarine, and generally produces, with alumina mordants, a somewhat redder shade than madder. This is due to some impurities, whose nature is. as yet, not known. Schunck has, however, already succeeded in obtaining a yellow crystalline body from the residues; but this yellow substance does not appear to have any affinity for mordants, and therefore cannot be injurious.

A good deal has been said about the supply of anthracene. It must be remembered, however, that tar distillers have had as yet but little experience in separating this substance. Mr. Perkin's investigations on this matter have led him to believe that coal-tar contains considerable quanties of this hydrocarbon. No doubt the kind of coal used as well as the temperature employed in the gas works, influences the quality of the tar as a source of anthracene, but upon these points no definite information has yet been obtained.

Mr. Perkin illustrated his highly interesting lecture by exhibiting samples of fabrics dyed and printed with artificial alizarine, and also by projecting the spectra of some alizarine solutions on a screen.

The following paper was "*On the Combinations of Carbonic Acid with Ammonia and Water*," by Dr. Divers, the reading of which, however, was, on account of the advanced hour, postponed for the next meeting, when, besides this, the following papers will be read: "Deep Sea Water," by John Hunter, and "Refraction Equivalents of Aromatic Hydrocarbons," by Dr. Gladstone.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, February 8, 1870.

J. P. Joule, LL.D., F.R.S., *President, in the Chair.*

Mr. Spance repeated the experiment he had made at the Exeter meeting of the British Association, showing that the temperature of saturated saline solutions could be raised to their boiling points by merely passing through them ordinary steam at a temperature of 212°. Thus a solution of chloride of sodium was raised to a temperature of 221°, and one of chloride of calcium to 248°. Chloride of sodium would have risen to 224·3° and chloride of calcium to 286° had the experiment been continued, but the point was sufficiently demonstrated that by steam of 212° much higher temperatures can be obtained.

Ordinary Meeting, February 22, 1870.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., *President in the Chair.*

The President referred to the observations he had made in former years on the progressive rise of the freezing point of one of his thermometers, published in the Proceedings for April 16, 1867. He had made a further observation on the 12th February inst., and found that a rise, which though very small was unmistakable, was still taking place after a lapse of time of 26 years since the bulb was blown. The results are as follow in indications of the thermometer, calling the first observation in April, 1844, zero. 12·9 divisions of the thermometer correspond to one degree Fahrenheit.

April,	1844	0
Feb.,	1846	5·5
Jan.,	1848	6·6
Feb.,	1853	8·8
April,	1856	9·5
Dec.,	1860	11·1
March,	1867	11·8
Jan.,	1868	11·92
Feb.,	1870	12·02

Dr. F. Grace Calvert, F.R.S., stated that he did not intend to read a paper on *artificial alizarine*, some of the facts he was going to bring before the notice of the meeting being well known to his colleagues, the chemists of this district, but he hoped it might be interesting to the general members of the Society to have an idea of the progress that had been made during the last few months in the production of this substance. They were aware that alizarine was the essential colour-giving principle of the madder root. Every cultivated mind in Lancashire ought to be acquainted with each step made in the artificial production of this dye, owing to the immense capital involved in the cultivation of the madder plant in the working of it up in this country, as well as the revolution it will effect in our commercial relations and the important new branches of manufacture it will create.

It was well known to the members of this Society that about 12 months ago Messrs. Graebe and Liebermann had discovered a method of producing alizarine from a coal-tar product, which up to that time had attracted very little attention, even in the scientific world, viz., anthracene, $C_{14}H_{10}$, and that by oxidation they transformed it into anthraquinone, $C_{14}H_8O_2$, which in turn was changed into bibromanthraquinone, $C_{14}H_6B_2O_2$, this being converted into alizarine, $C_{14}H_8O_4$, by the addition of two equivalents of oxygen and the formation of two equivalents of hydrobromic acid.

It was felt by all chemists that this discovery was one of great importance, though it was too complicated to be commercially useful, but the Gordian knot being now cut, the commercial production of artificial alizarine was merely a question of time, and what he would now relate showed the marked progress which had been made toward this end.

There were already three patents published; and one process, the details of which are kept secret, is being worked by Messrs. Meister, Lucius, and Co., of Hœchst, near Frankfort. The patents are those of Messrs. Brænnan and of Gutzkow, of Messrs. Caro, Graebe, and Liebermann, and Mr. W. H. Perkin. It was curious to notice that the patent of Messrs. Caro was dated the 25th of June last, and Mr. Perkin's the 26th of the same month; and that all these patents effect the same purpose by simply employing different oxidising agents. Messrs. Brænnan and Gutzkow oxidise the anthracene into anthraquinone by means of the nitrate of protoxide of mercury, Messrs. Caro by peroxide of manganese, and Mr. Perkin employs oxanthracene, and then all by further processes, which are nearly the same, convert anthraquinone into alizarine.

As it might be interesting to many of the members to have an outline of one of the methods employed, he would therefore describe a process detailed in the specification of Messrs. Caro, Graebe, and Liebermann. One part of anthracene is heated with four of sulphuric acid, of specific gravity 1·845, for three or four hours, to a temperature of 212° F., and then for about an hour at 300°. The mixture is allowed to cool, and to it is added water equal to three times the weight of the anthracene employed, and manganese equal to four times that weight.

The whole is boiled for three hours and milk of lime added, which gives rise to a deposit consisting of the excess of lime and manganese used and protoxide of manganese,

while there remains in solution a double sulphate of anthraquinone and lime. This solution is now acted on by carbonate of soda in slight excess, carbonate of lime separates, and the salt of soda thus produced is evaporated to dryness. This solid mass is then mixed with two or three parts of caustic potash or soda and a small quantity of water, and the whole heated under pressure in suitable vessels at a temperature of 350° to 500° F. for one hour, when the anthraquinone is further oxidised, and converted into alizarine. The alkaline mass, on cooling, is dissolved in water, and sulphuric or acetic acid added in slight excess, when an orange-yellow, flocculent substance precipitates, which, when properly washed and dried, is artificial alizarine.

If this process can be carried out on a practical scale (and there is no doubt that it will be, under the direction of such clever chemists as Messrs. Perkin, Caro, and others), we may then fairly consider the production of artificial alizarine as having reached the sphere of commercial application; though I may add, from personal experience, that some time must elapse before it can be manufactured in quantities sufficient to affect the present applications of madder, garancine, Schunck's commercial alizarine, &c.

There is another great difficulty yet to be overcome before the artificial alizarine can become a commercial article, that is, the obtaining of anthracene in larger quantities, and this question is of some importance to us, England being the great tar producing country. Anthracene does not appear to exist in greater proportion than one in a thousand of tar, and is only liberated or produced during the latter part of the distillation of the tar. In fact, if the distillation be stopped so as to leave a very soft pitch, the oils obtained give little or no anthracene. If, on the other hand, it is carried on so as to get 10 or 15 per cent more oil off, there remains a hard pitch which has little or no value at the present day, the quantity of anthracene obtained varying very much according to the nature of the coals employed in the production of the tar, ranging from 1½ to 8 per cent of the heaviest oils separated; it will scarcely be worth the while of the tar distiller to depreciate the value of one of the staple articles of his trade to produce it, and even when the heavy oil is obtained the separation of the small quantity of anthracene it contains, and its purification for use according to the above patents, will yet require much time and research. It is well known to all who have worked on the coal-tar products that each well-defined compound is mixed with homologues which renders its separation and purification a work of extreme difficulty; thus aniline is mixed with picoline and several other alkaloids, benzol with toluol and other hydrocarbons, carbolic acid with cresylic and other acids, and anthracene is also mixed in a similar manner with homologous compounds.

The mere distillation and filtration of the solids obtained and their hot or cold pressing, or even their sublimation, do not effect the complete purification of the substance. The purest product I have been able to obtain on a moderate commercial scale has contained, when cold pressed about 40 per cent, and when hot pressed about 70 per cent of anthracene. One of the chief difficulties in its preparation is the fact of its great solubility in its liquid homologues at a moderate temperature, thus an oil, at 40° or 45° F., will yield a comparatively large quantity of anthracene by filtration, but if its temperature be raised to 70° or 80°, the anthracene will be completely dissolved.

I am aware that it has been proposed to distil soft pitch so as to obtain the volatile products that are given off in coaking it, but the expense, difficulty, and danger of such an operation are such that I doubt if they can be overcome so as to produce anthracene of comparative purity on a commercial scale.

Papers have been published respecting the identity of the alizarine produced by the process of Messrs. Meister, Lucius, and Co., with natural alizarine, by Dr. Schunck, Professor Bolley, and Messieurs Emile Kopp, Camillo Kœchlin, La Fraisse, G. Wallace Young, and J. Christie. The opinions of these chemists vary. Dr. Schunck and Professor Bolley consider it identical, the other gentlemen considering it not identical, some of them maintaining it to be a mixture of purpurine and alizarine.

The product made according to the patents mentioned I have not had an opportunity of examining, nor have I seen any papers on the subject in any of the scientific journals which have reached my hands; but as doubtless it will shortly be before the public, I shall take an early opportunity of laying before the society the results of my own experience as well as those of others.

In conclusion, I think many years must elapse before artificial alizarine can replace madder and its preparations in all their varied applications in calico printing, but ere long the purity of the substance, artificially obtained, may prove of great service to the calico printer, by enabling him to produce, at a cheaper rate than now, certain styles of prints as well as new styles and effects.

Specimens of anthracene, artificial alizarine, and dye fabrics were exhibited.

Dr. Schunck, F.R.S., remarked that the practical success of the new process would in a great measure depend on the price of the raw material, anthracene, and on the amount of colouring matter to be obtained from it. The process itself was, however, as far as the few experiments he had made allowed him to judge, a very simple and easy one, requiring the use of no costly materials. He was convinced himself that the artificial product was identical with the natural alizarine of madder, the only difference being that the former was generally contaminated with some impurity which prevented its crystallising easily. Purpurine was not formed along with alizarine, as had been supposed. He also exhibited to the meeting some specimens of Turkey-red dyed with artificial alizarine, which had been sent to him by Mr. Perkin, and stated that the latter had already manufactured several tons of the new product.

In connection with this subject Dr. Schunck referred to a notice contained in the Chemical News (vol. xxi., p. 81; *Am. Repr., April*, '70, *page* 207), giving an account of a process for preparing pure alizarine from Turkey-red dyed cotton. The author, M. Schützenberger, does not state that the process is new, though he seems to claim it as his own. Almost the same process was, however, described many years ago by Dr. Schunck, who claims, indeed, to have been the first to point out that Turkey-red, madder pink, and all the finer madder colors are simply compounds of alizarine and fatty acids with bases. The experiments on which this conclusion was founded were described in the edition of "Ure's Dictionary of Arts," published in 1859, under the heads of "Madder" and "Turkey-red," but the experiments themselves were made at a much earlier date.

"*On the Organic Matter of Human Breath in Health and Disease*," by Dr. Arthur Ransome, M.A.

The vapour of the breath was condensed in a large glass flask surrounded by ice and salt, by which a temperature several degrees below zero was obtained. The fluid collected was then analysed for free ammonia, urea and kindred substances; and for organic ammonia—the method employed being that invented by Messrs. Wanklyn and Chapman for water analysis.

The breath of eleven healthy persons and of 17 affected by different disorders was thus examined, and the results were given in two tables.

The persons examined were of different sexes and ages, and the time of the day at which the breath was condensed varied.

In both health and disease the free ammonia varied considerably, and the variation could not be connected with the time of the day, the fasting or full condition. Urea was sought for in fifteen instances—three healthy persons and twelve cases of disease—but it was only found in two cases of kidney disease, in one case of diphtheria, and a faint indication of its presence occurred in a female suffering from catarrh.

The quantity of ammonia, arising from the destruction of organic matter, also varied, possibly from the oxidation of albuminous particles by the process of respiration; but in healthy persons there was a remarkable uniformity in the total quantity of ammonia obtained by the process. Amongst adults the maximum quantity per 100 minims of fluid was 0·45 of a milligramme, and the minimum was 0·35.

A rough calculation was given of the total quantity of organic matter passing from the lungs in twenty-four hours—in adults about 3 grs. in 10 ozs. of aqueous vapour, a quantity small in itself, but sufficient to make this fluid highly decomposable, and ready to foster the growth of the germs of disease.

In disease there was much greater variation in the amount and kind of organic matter given off.

In three cases of catarrh, one of measles, and one of diphtheria, the total ammonia obtained was much less than in health—less than 0·2 of a milligramme—a result probably due to the abundance of mucus in those complaints, by which the fine solid particles of the breath were entangled.

In two cases of whooping cough it was also deficient, but as they were both children, the lack of organic matter may have been due to their age.

In cases of consumption, also, the total ammonia was less than in health; but in one case of this disease associated with Bright's disease a large amount of organic matter was given off, a portion of it due to urea.

In kidney diseases the largest amount of organic matter of all kinds was found in the breath. The ammonia in one case of Bright's disease was 1·8 milligrammes in 100 minims of fluid, and urea was largely present. Perhaps this fact might be taken as an indication of the need of measures directed to increase the activity of other excretory organs.

In one case of ozona or offensive breath the total quantity of ammonia obtained was greater than in any healthy subject, but the excess was chiefly due to organic matter.

One convalescent case of fever was examined, and the total ammonia was found to be deficient.

The air of a crowded railway carriage, after fifteen minutes occupation, was also tested by this method, and in about 2 cubic feet 0·3 milligrammes of ammonia and 3 milligrammes of organic matter were found.

With reference to the presence of organic matter in the atmosphere, it was pointed out that the subject was in no way a novel one, and that it had, during the last thirty years, been very fully investigated by many observers, more especially by Schwann, Dusch, Schroeder, Helmholtz, Van den Broeck, Pasteur and Pouchet, but it was shown that it is to Dr. Angus Smith that we owe the discovery of the readiness with which living organisms are formed in the condensed breath of crowded meetings, and the determination of the actual quantity of organic matter in the air of different localities.

Mr. Dancer's calculation of the number of spores contained in the air was noticed, but a source of error was pointed out in the readiness with which organisms are developed in suitable fluids, even in the course of a few hours. Observations upon the organic particles of respired air had at different times been made by the author.

1. In 1857, glass plates covered with glycerine had been exposed in different places and examined microscopically. Amongst others, in the dome of the Borough Gaol, to which all the respired air in the building is conducted, organised particles from the lungs and various fibres were found in this air.

2. During a crowded meeting at the Free Trade Hall air from one of the boxes was drawn for two hours through distilled water, and the sediment examined after thirty-six hours. The following objects were noted:—Fibres, separate cellules, nucleated cells surrounded by granular matter, numerous epithelial scales from the lungs and skin.

3. The dust from the top of one of the pillars was also examined, and in addition to other objects, the same epithelial scales were detected.

4. Several of the specimens of fluid from the lungs were also searched with the microscope. In all of them epithelium in different stages of deterioration was abundantly present, but very few spores were found in any fresh specimen. On the other hand, after the fluid had been kept for a few hours, myriads of vibriones and many spores were found.

In a case of diphtheria, confervoid filaments were noticed, and in two other cases, one of measles and one of whooping cough, abundant specimens of a small-celled torula were found, and these were seen to increase in numbers for two days, after which they ceased to develop.

These differences in the nature of the bodies met with probably show some difference in the nature of the fluid given off; but it was pointed out that they afford no proof as yet of the germ theory of disease. They simply show the readiness with which aqueous vapour of the breath supports fermentation, and the dangers of bad ventilation, especially in hospitals.

Dr. E. Lund and Dr. H. Browne stated that they had also made experiments, the results of which were, in general, confirmatory of those obtained by Dr. Ransome.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

Ordinary Meeting, February 14, 1870.

Mr. E. C. C. Stanford, F.C.S., *in the Chair.*

The first paper was on "*Some Notes on Californian Borax,*" by Mr. Archibald Campbell, St. Rollox Chemical Works. The author referred briefly to the borax as obtained from Thibet under the name of tincal; and that of the Lagoons of Tuscany, and then he spoke of the boracic compounds obtained within the last few years in Peru. In the latter case, the deposit consists chiefly of borate of lime, with varying quantities of borate of soda. Having spoken at some length on the Peruvian deposits and of the opinions expressed by Mr. Walker (Chemical News, vol. xviii., p. 203; *Am. Repr., Dec.* '68, *page* 322), regarding their origin, Mr. Campbell stated that borax had lately been found at Halberstadt in Transylvania, in Ceylon, in several mineral springs in Canada East, and in the waters of the sea along the coast of California. The most important discovery of borax in recent years is that of the Borax Lake of California, a description of which was given by Mr. Campbell. It is about 40 miles from the Pacific, and 60 miles from Suisum Bay. Between it and Clear Lake (a lake about 25 miles long) there is a large accumulation of volcanic materials, containing much obsidian and pumice-stone, lying loosely heaped together in a ridge which separates the two lakes; in fact, all through the mountain ranges on the coast in the region under notice, there are hot springs and the remains of solfatara action. These strongly indicate a cross fracture through which the volcanic agencies have made themselves perceptible, and which probably forms a connection on the south-west with the geysers, thus forming a line of volcanic action nearly, if not quite, across the mountain chain. It is in this peculiarly volcanic action that the Borax Lake is situated. The lake is of variable size, according to the season of the year and the comparative dryness of the season. In September, 1863, the water occupied an area of about 4000 feet long, and 1800 feet wide in the widest part. Its length has been twice as great as it is at present, as is evident from the nature of the ground. In some very dry seasons, the lake is rendered entirely dry: in September, 1863, however, the water was about 3 feet deep. The existence of the lake was first made known to the world by Dr. Veatch, who examined it in September, 1856, and detected borax in its waters. It was not until some months afterwards that the existence of a large bed of borax crystals was discovered in the bottom of the lake. The land in the district belongs to the Californian Borax Company.

The water collected from the lake in 1863, on being analysed, was shown to contain 2401·56 grains of solid matter per gallon, of which about one-half was common salt, one-fourth

carbonate of soda, and the remainder chiefly borate of soda—there being 281·48 grains of the anhydrous borate, equal to 535·08 of crystallised borax to the gallon, or, in other words, 13 gallons of the water are equal to 1 lb. of the borax crystals. Traces of iodides and bromides were also found. A sample of water taken from a coffer-dam sunk in the middle of the lake was more concentrated. There were 3573·46 grains of solid matter per gallon; but the same ingredients were found, and in nearly the same proportions as in the water of the lake itself. The crystals vary in size, from those which are microscopic to such as are 2 or 3 inches across. They are mixed with bluish mud, and sometimes there are several alternating layers of mud and crystals of borax. It is believed that there are several thousand tons at the bottom of the lake. The crude borax is obtained so pure that it is used by the San Francisco assayers in preference to the refined borax imported from abroad. In the neighbourhood of the lake, there is a hot spring of a remarkable character, and said to yield about 300 gallons per minute. Mr. Campbell gave the following analysis of the water of the spring, the figures representing grains per gallon:—

Chloride of potassium	trace
" " sodium	84·62
Iodide of magnesium	0·09
Bromide of magnesium	trace
Bicarbonate of soda	76·96
" " ammonia	107·76
Biborate of soda	103·29
Sulphate of lime	trace
Alumina	1·26
Carbonic acid (free)	36·37
Silicic acid	8·23
Matter volatile at a red heat	65·77
	484·35

These figures necessarily represent anhydrous salts and, therefore, the 103·29 grains of biborate of soda represent 195·35 grains of crystallised borax.

The author had not ascertained the temperature of the spring, but it could not be high, owing to the great amount of bicarbonates, and from carbonic acid present in solution. He considered the most extraordinary feature of the analysis to be the very large quantity of ammoniacal salt present—exceeding, he believed, that of any spring yet analysed.

Mr. Campbell afterwards read a short paper on "*Notes on Silician Sulphur.*" He gave an account of the mode in which sulphur is distributed in nature, and of the various theories held regarding the formation of sulphur deposits. Some peculiar properties of sulphur were next spoken of; and the author concluded by mentioning some details regarding the means adopted for the extraction of the sulphur from the mineral masses in which it occurs in Sicily.

The author exhibited several specimens of Californian borax and Silician sulphur. A short discussion followed, the remarks being especially directed to the peculiarities of the analysis given above and the probable source of the nitrogen of the ammonia.

The next communication was entitled "*On the Composition of Ooze or Chalk Mud from the Atlantic Sea Bed,*" by Mr. James Mahony.

The author spoke of the interest that has been felt regarding the nature of the Atlantic sea bottom, and the conditions of life there present, ever since the first surveys were made in connection with the Atlantic telegraph cable. Previous to that time Professor Edward Forbes had expressed the opinion that organised beings could not live at greater depths than 200 fathoms; but Dr. Wallich had shown that animal life did exist even at a depth of 1260 fathoms, and that it was represented by various species of starfish and *Globigerina;* and, further, that the comparatively level plateau extending from Ireland to America was covered by a fine white mud, to which the name of "ooze" had been given. Mr. Mahony then referred to the deep-sea dredging expeditions of H.M.S. *Porcupine*, and stated that he had been favoured with a sample of the ooze lately sent to a scientific friend in Glasgow, by Professor Wyville Thomson. It was obtained from the deepest dredging, 2435 fathoms, about 150 miles west of Ushant, the temperature of the sea bottom being 36·5°. Part of the sample was air-dried and a small portion was put, when fresh, into methylated spirit. Mr. Mahony had examined the ooze both as a chemist and as a naturalist. The following is the analysis:—

Silica	26·60
Peroxide of iron and phosphates	3·80
Protoxide of iron	0·08
Carbonate of lime	58·80
Carbonate of magnesia	1·76
Sulphate of lime	trace
Soluble salts	4·20
Organic matter	2·30
Water	2·50
	100·04

The silica was found under the microscope to consist chiefly of minute structureless fragments, some of them being crystalline. A small number of diatoms were also found. The calcic carbonate consisted of larger organisms (class *Foraminifera*), some still containing the small particle of jelly-like matter constituting the animal substance of these organisms, and called *sarcode* by Dujardin. These doubtless yielded the organic matter noted in the analysis. The soluble salts were accounted for by the evaporation of the sea water with which the mud was charged when taken up.

Mr. Mahony then considered the question—"Does the presence of the gelatinous contents of the foraminifers indicate that they live and die on the sea bottom?" So far as the aëration of the water was concerned, he found no difficulty, especially when looking at the subject in the light thrown upon it by Mr. John Hunter's recent paper "On Analysis of Sea-Water Performed on Board the *Porcupine.*" (*Journal of the Chemical Society* for January, 1870.) He concluded his paper by stating that over the North-Atlantic sea-bed the chalk formation is in continued progress, the identity of the ooze with chalk, both chemically and organically, being very apparent. The siliceous grains have their counterpart in the layers of flint seen in the chalk cliffs,—probably formed by the aggregation of minute particles round a central nucleus,—while the species of minute shells found in the ooze are in many cases identical with those entombed long ages ago.

A short discussion followed, and then Mr. Stanford vacated the chair to read two short papers. The first was entitled "*Note on a Specimen of Shell Sand from the Island of Coll.*" The specimen examined had the following analysis:—

Carbonate of lime	68·50
Carbonate of magnesia	1 51
Silica sand	25·69
Phosphates, iron, and alumina	2·00
Organic matter	2·30
	10.000

It was very much agglutinated, owing to the carbonate of lime which the rain-water had taken up and afterwards deposited over the exposed grains of sand. The author mentioned that most of the islands of the Outer Hebrides have similar deposits of sand on their west coast, the east being covered with peat. The sand is generally composed almost entirely of the *débris* of shells of countless generations of mollusca. In the silica sand mentioned in the analysis there was felspar, and therefore potash. A trace of nitrogen was present in the organic matter. The specimen was much weathered, and, therefore, did not contain as much nitrogen as there would doubtless have been in the fresh state.

Where the sand does not "blow" it bears a luxuriant crop of white clover, which is specially remarkable in North and South Uist. The presence of magnesia shows it to be a good food for clover. By mixing the shell sand with the peat an excellent soil is produced. With lime it forms a remarkably strong mortar, almost equal to a cement.

Mr. Stanford's next paper was a "*Note on Iodide of Cyanogen*," the result of the examination of a specimen of that compound which he had recently found while resubliming a lot of inferior iodine purchased in London. Although the impurity was said to be a common one, he had never met with it in any quantity before. Mr. Stanford detailed its properties and its reactions.

QUEKETT MICROSCOPICAL CLUB.

The annual *conversazione* of this club took place at University College on Friday evening, and was attended by a very numerous assembly of members and visitors.

The objects exhibited under the microscopes comprised specimens from nearly every branch of microscopical science, and evinced by their novelty an evident desire on the part of the members to cultivate every source likely to yield instruction. Amidst so much to attract attention it is impossible to make a selection; we may, therefore, merely remark that amateurs and professionals were equally assiduous in contributing to the general entertainment of the company. In addition to the objects exhibited, an interesting collection of photographs lent by the India Office, the Autotype Company, Mr. Frank, Mr. Good, and Mr. A. L. Henderson were much admired.

The whole process of micro-photography was demonstrated at frequent intervals by the Messrs. Solomon, the actinic influence being derived from their new magnesium lamp. Mr. Apps exhibited some large Gassiot's cascades and Geissler's tubes illuminated by his celebrated induction coil, and Mr. James How displayed Dr. Maddox's micro-photographs and some views of Swiss scenery, &c., by the aid of the oxy-hydrogen light. The meeting may be described as eminently successful.

NOTICES OF BOOKS.

Reports on the Progress of Practical and Scientific Medicine in different parts of the World. (For the year beginning June 1st, 1868, and ending June 1st, 1869) Edited by Horace Dobell, M.D., &c., assisted by numerous and distinguished coadjutors. London: Longmans, Green & Co., 1870. Pp. 645.

In the preface to this work, the editor asks his readers "to accept this first year's report as a fragmentary hostage of the next; it was only last December that I designed this work, and since that time I have had to open up correspondence with all parts of the world. The design of this work is to bring together in the English language, original and independent reports from all parts of the world, written by distinguished men resident in the countries they represent." As regards the contents of the work it is a genuine *varietas delectat*. The book opens with a comparative table of weights, measures, &c., and also a table of comparison of the Fahrenheit with the Centigrade and Réaumur's thermometer; the arrangement is alphabetical, and therefore Africa takes precedence. Under this heading we meet with a very valuable record of meteorological observations on the West Coast of Africa, by Dr. J. A. B. Horton, arranged in the following manner:—Atmosphere; Exemption from what Diseases; Predisposed to what Diseases. America, as might be expected, is very well represented, and we learn from the work that this report is the production of a new society just set on foot at New York, for reporting the progress of medicine; and, owing to the embryonic condition of this society, it is not so complete as future reports will be. It is quite impossible to give in a few lines an adequate idea of the large amount of valuable and interesting matter contained in this volume. As an instance of the great variety of matter, we have an excellent paper on "Cider Colic," by J. Buckman; "On the Treatment of Pulmonary Consumption by Ether and Etherised Cod-liver Oil," Dr. B. W. Foster; there are also reports from several European countries, including remote Iceland; but we do not find reports from Russia, Spain, the Netherlands. From the colonies of the latter country there is a report by Dr. Wylie. Taking matters *en resumé*, we have to congratulate the editor on his first production.

A Dictionary of Scientific Terms. By P. Austin Nuttall, LL.D., Editor of "The Classical and Archæological Dictionary," "Standard Pronouncing Dictionary," and numerous educational works. London: Strahan & Co, 1869. 8vo.; pp. 325.

The object of this work is "to render the language of science intelligible not only to the professional student but to the general reader." It has been specially arranged with a view to educational purposes, and to further the working of the revised code which was framed a short time ago by the Committee of the Council for Education. Dr. Nuttall's book is dedicated "By special permission to the Right Honourable Robert Lowe, Chancellor of Her Majesty's Exchequer, and the eloquent representative of University *College* (*sic?*), London." Now, the Right Honourable Robert Lowe is not only Chancellor of Her Majesty's Exchequer, but Master of Her Majesty's Mint, and in these combined capacities he is at this moment preparing a Bill to consolidate and amend the laws relating to the coinage and the Mint. With such a subject, what can be more natural than that he should turn for some piece of technical or scientific information to the work so recently, and "by special permission" dedicated to him, and of which it may be reasonable to suppose he possesses an elaborately bound and large-paper copy? He seeks for—what shall we say?—*metals*, as most *apropos* to his new position, and at page 17 of the introduction, he reads, "A few of the principal metals are here given in alphabetical order:—

Antimony.	Copper.	Manganese.	Silver.
Arsenic.	Gold.	Mercury.	Steel.
Bismuth.	Iridium.	Nickel.	Tin.
Black-lead.	Iron.	Ochre.	Tungsten.
Brass.	Lead.	Pewter.	Zinc."
Cobalt.	Magnet.	Platinum.	

"I had no idea," muses the Right Honourable gentleman, "that black-lead and ochre were reckoned among the principal metals, but science is making wonderful strides now-a-days." Next he specialises, and turns to gold, silver, copper. Gold is found to be "the most valuable and ductile of all the metals, and is used by all civilised nations as a standard of value;" it "unites with most other metals, and with sulphur, ammonia, &c." "Silver is one of the fifty-five simple or elementary bodies, and included in the sub-division termed metals nearly white." "The ores of copper are very numerous, the principal being sulphuret of copper and iron (iron pyrites), and sulphuret of copper (nitrous copper ore)." Let us sincerely hope (and, if necessary, memorialise the Right Honourable gentlemen on the subject) that Mr. Lowe will not ordain this the text-book of the Treasury, will not have it employed by candidates for Civil Service appointments, will not get up his chemistry and metallurgy and general science from it. Now, if a new or modified code of taxes were framed on its authority, we do not know what would become of us, had we not Dr. Playfair in the House to see fair play in regard to all that relates to *scientia immutabilis*.

Now we fully recognise and admit the difficulty and labour of compiling such a work as that before us. We wish to make every allowance for this difficulty, and we assure

Dr. Nuttall we would always rather praise than blame. If his soul be in law or literature, while his body, for the time being, is in science (like the man in the old Spanish song whose body was in Segovia while his soul was in Madrid), we have the more sympathy for him. He has told us in the preface that "occasional omissions or oversights may possibly be discovered," and he has asked "every indulgence from a generous public." We will respect this; it may be thought we have been seeking omissions and errors; now on our word of honour we will open the book several times at random, with our eyes shut, and thereupon criticise without favour and with our eyes open. "Crater, the mouth of a volcano. In *astrology*, a constellation in the southern hemisphere. Cretinism a species of *idiotism* with which the goitrous inhabitants of the alpine valleys are afflicted." "Fluoric Acid = 3 atoms of fluorine + 1 of boron, equiv. 66·98." (The last example p. 154, left-hand column.) "Chloride of Potash, a valuable compound prepared by passing chlorine gas into a mixture of 1 lb. of caustic lime, and 1 lb. of potash, with 8 lbs. of water." O! Dr. Nuttall, hard worker and earnest though you may be, we must tell you that this is not the science of to-day. We do not quote Werner for geology, Hoblyn for chemistry, Howard for meteorology, Craig for mathematics, or "the intelligent author of 'The Traveller's Remembrancer,'" for anything whatsoever. We neither know their names, nor recognise their authority. We do not use such terms as *hydroguret*, *electrology*, *fluate of lime*, *hydropneumatic*, *physicologist*, nor do we include hydrostatics in hydrodynamics (p. 184). This is partly the science of another age, partly the science of no age at all.

And now, before leaving the work, let us return once more to the introduction. It is headed by what we suppose is the key-note of the work, the phrase which Colonel Newcome loved to quote, which the Padre Cura of Guadarrama persisted in attributing to Cicero, and which comes to most of us at an early age *viâ* the Latin grammar, and the syntax therein, and the troublesome nominative to the verb:—

> "Didicisse fideliter artes
> Emollit mores, nec sinit esse feros."

But why has our author omitted the "*Ingenuas?*" Injured shade of Ovid, you have our sympathy. Are not the arts of which he treats ingenuous? We feel bound to confess that they could not be learnt faithfully from the work before us if they were, so perhaps it is as well to maim the lines altogether; and we would further (with apologies to the reader) state that the learning of the arts, especially those appertaining to the extracts given above, out of this book has quite a reverse effect to that conveyed by the Ovidian maxim, for it makes us exceedingly *ferus*. Not far removed from "Didicisse, &c.," in the Latin grammar, our author may remember another phrase, which he may be inclined to say to us after perusing the above remarks: "Vos damnâstis; (*quasi dicat* præterea nemo") but we assure him in this case the nominative of the pronoun need not be expressed; it is not we alone who have condemned; we must say *Damnaverunt* without the pronoun, and we regret it for his sake.

First Lessons in Inorganic Chemistry. By T. Ward, F.C.S., &c. Manchester: John Heywood. London: Simpkin, Marshall, and Co. 286 pages.

There is already more than a superabundance of small text-books and manuals on chemistry; and it is a matter for wonder that, while there is no lack of really excellent books for young pupils, so many authors rush into print, imagining that they can improve upon what exists, and evidently forgetting "*Comment fait on des livres? Avec des livres.*" Let us briefly glance at the contents of this little volume. It partakes, in its arrangement, of two excellent works—viz., Stöckhardt's well-known book, and the small volume written by Professor Roscoe. We are sorry to be compelled to say that Mr. Ward's book is inferior to each of these, individually, as it is deficient in that lucid and precise clearness of exposition and soundness of definition which so eminently characterises the two works just alluded to. While we thus express our opinion, we must in all fairness also say that, as far as we have perused Mr. Ward's book, we have not found therein any heterodox or incorrect statements. The book is well got up, is provided with woodcuts, and contains some very useful tables relating to weights and measures, thermometer degrees, and a copious index. There is also added a chapter on qualitative analysis, which is, however, too brief to be of much use.

An Introduction to the Study of Chymistry, written for the People. By Cuthbert C. Grundy. London: Simpkin, Marshall, and Co. 1870. 108 pages.

Our first remark applies to the use and spelling of the word *chymistry*. Although the origin, or primitive meaning of this word is not satisfactorily explained, there is little doubt about the proper spelling, omitting even for the moment so old an origin as that which is sometimes assigned to chemistry as the Egyptian art, or as the secret art of transmutation, as practised by the Chémi (the Koptic for Egyptians). It is undeniable that Zosimus, in the fifth century of our era wrote χημεια, derived from χεω, or χευω (*to melt*, or *to fuse*); but there certainly is no warrant for using the *y*, since neither the Greek substantive nor the verb contains the υ placed as this author would have it. As to the contents of the book, while admitting that there is in it a large amount of useful information, it is equally true that it is, in many respects, a curious *olla podrida;* and this especially applies to the attempt evidently made of compressing a great deal into a very confined space. On page 20, we read—"There are two kinds or classes of matter. Matter which has been formed by the action of animals or of plants, or which is part of an animal or of a plant, is called organic matter; because it is a part of the substance of the organs of the animal or of the plant, or is produced by these organs. Wood is an organic substance, because it is a part of the plant; starch is organic matter, because it is formed by the organs of the plant; flesh is organic matter, because it is part of the animal." It would seem that the author has no idea of the distinction to be made between *organized* and *organic* substances or matter. The book is by no means free from incorrect statements—*e. g.*, page 83 we read—"For chlorine cannot bleach mineral colours." How, then, does it act upon ultramarine, or upon Scheele's green? Of phosphorus, we read that it can be obtained in the free state only by artificial means; this is, of course, quite correct, but this equally applies to silicon, of which it is said it is not found in free state, while, according to the author, boron is not known in free state—a statement which is quite incorrect, for it may be obtained in the free state by artificial means just as well as phosphorus and silicon.

The appendix is the best, and, in many respects, most valuable part of the book, since in it are given the rules applying to decimal fractions, the decimal system of weights and measures, and the value thereof according to the English system. The author has, we fear, written rather hurriedly; and, by trying to compress too much information in a small space, sacrificed that clearness which should characterise a book of this nature intended for the great body of the people.

CORRESPONDENCE.

Monad Elements.

To the Editor of the Chemical News.

Sir,—In the Chemical News (vol. xxi., p. 80; *Am. Repr.*,

April, '70, *page* 205), Mr. George Davis has touched upon a subject especially interesting to me, as, during the last thirteen months, I have made it my study. Many circumstances (among which a prolonged absence in the country, away from all books of reference, and a wish to collect more and more evidence in their support) have combined to defer the publication of my views of the so-called monad clements; I hope, however, now speedily to make them known. I may shortly state that, by assuming triad functions for the univalent class of bodies, I have been able to explain the existence of many compounds hitherto unclassified and regarded, as Mr. Wanklyn says, as "freaks of nature."—I am, &c.,

Walter Noel Hartley.

Dr. Odling's Laboratory, Royal Institution,
February 23rd, 1870.

Shell Sand from the Island of Coll.

To the Editor of the Chemical News.

Sir,—In the report of my short paper on "Shell Sand" in your last number, there is an error which I beg you will allow me to correct. I did not say that shell sand formed a strong mortar with lime, but that a strong lime was made from it by stacking it alternately with peat, and burning the stack; and that this lime, from the magnesia and silicic acid it contained, was in use almost equal to a cement.—I am, &c.,

Edward C. C Stanford, F.C S.

Edinbarnet, Dumbartonshire, N.B.
February 28, 1870.

[The report was forwarded by the gentleman nominated by the Council to do so.—*Ed. C. N.*]

The Rashness of Scientific Men.

To the Editor of the Chemical News.

Sir,—Your well-written and excellent contemporary, the *Spectator*, said, last week, that "it seems as if no class of men drew rasher or hastier conclusions than the men of science." This was *apropos* of a recent statement as to the effect of hard and soft water upon the human constitution. Now I should very much like to know who originated this statement. Surely, if a physician, he could not have been a chemist, and, if a chemist, no physician. The *Spectator*, generally intelligent and well-informed, persists, like the *Times*, in speaking of druggists as chemists, and probably shares, too, the popular opinion that a doctor necessarily knows all about analysis and the arcana of chemical science. The investigation of the present case will, I feel confident, result in showing that the rash and hasty conclusion complained of was not drawn by a genuine man of science competent to connect a chemical fact with a physiological phenomenon. There are too many *fungoid* or pseudo-scientific men, who seize upon the results of true philosophers, and misinterpret them to the popular theme.—I am, &c.,

C.

A New Dentists' Alloy for Stopping Teeth.

To the Editor of the Chemical News.

Sir,—I have recently examined a new dental alloy which is sold for the purpose of being used as the basis of an amalgam. It occurs in the form of rather coarse filings, nearly white. Warmed in an iron spoon with a little mercury, it soon enters into intimate commixture with it. The warm amalgam, if then pressed in wash-leather in a pair of pincers, loses much mercury, and the dry amalgam thus obtained is ready for insertion into the cavity to be stopped. Its manipulation altogether much resembles that of the celebrated copper amalgam, and it seems to be quite as useful though not so hard. But it possesses this advantage over the copper amalgam (which darkens greatly) that the new amalgam retains its whiteness in the mouth. On analysis the original metal as sold gave:—

Tin.....	61·12	per cent
Silver.....	38·76	" "
Copper, &c.,.....	0·12	" "
	100·00	

I am, &c.,

C.

Memorial or Monument?

To the Editor of the Chemical News.

Sir,—It is reported that the Faraday Memorial, for which about £1400 has been subscribed, is to take the form of a "Monument in the British Museum." I hope the report is not authentic. The project is inappropriate, useless, almost ludicrous. Faraday hated monuments, and the British Museum, which has no department of chemistry or physics, is about the last place where one would expect or wish to see a statute of our great natural philosopher. The best memorial for a great worker would be the creation of a reward or stimulus for further work. Why not found a Faraday Scholarship, or award annually a money grant and medal for a great discovery in chemistry or physics? Whatever be done should be in connection with the Royal Institution, the scene of Faraday's life and labours. The experience of the Wollaston Fund which is connected with the Geological Society, affords an excellent precedent for the present case. Our English experience in busts and statues (especially when posthumous) is not so happy as to encourage us to risk an additional failure.—I am, &c.,

A Subscriber to a Memorial,
not a Monument.

Quantivalence of Sodium, &c.

To the Editor of the Chemical News.

Sir,—From the letters of Mr. G. E. Davis, and Mr. Noel Hartley, which have recently appeared in the Chemical News, it would seem that these gentlemen consider that there is something quite new in regarding sodium, potassium, &c., as capable of acting as triads and pentads. Now, I respectfully submit that there is no great novelty in the matter; such views having been put forth by several chemists at various times, but, without going further into the subject, I will simply call attention to a paper which I wrote on this question (Chemical News, vol. xvi., p. 43, July 26, 1867; *Am. Repr., Sept.* '67, *page* 128), with the object of showing "that reputed monads may, under certain circumstances, play the part of triads and pentads. Indeed, anyone who considers such compounds as that of potassium with hydrogen and fluorine, KHF_2, and that of silver with hydrogen and iodine, $AgHI_2$, can hardly fail to regard one at least of the elements so combined as acting, for the time being, the part of a triad. Professor Wanklyn, however, is not content with regarding sodium as occasionally capable of triadic functions; he seems to argue that it is never a monad, and this extreme view appears to be quite untenable in the present state of science.

One word, in conclusion, with reference to the two classes into which Dr. Williamson has divided the elements, viz., those of even and uneven quantivalence, or, as Dr. Odling calls them, artiads and perissads; I believe that there is no hard and fast line between these two classes, and could produce

evidence on this point, but will, at present, merely remark that quantivalence must be regarded as a state or condition of matter, and not as an unalterable property attached to this or that element.—I am, &c.,

John A. R. Newlands, F.C.S.

13, Knowle Road, Brixton, S. W.
February 28, 1870.

Treating Excreta of Towns.

To the Editor of the Chemical News.

Sir,—I have just been shown an article in the Chemical News of October 22nd, 1869 (vol. xx., p. 196; *Am. Repr., Dec.* '69, *page* 347), on "A Chemical Method of Treating the Excreta of Towns," by Edward C. C. Stanford, F.C.S. It may be interesting to your readers to have a short description of the system of conservancy I have persistently been trying to introduce into India for the last eighteen months. I must premise that, in tropical climates, the evils of the water sewage are greatly increased. The water with which the sewers are flushed is hot; putrefactive fermentation takes place very rapidly, as, also, does fungoid vegetation. The system I propose is to carbonise the filth in retorts, and to utilise the gas for heating the furnace and for illuminating. The filth is thoroughly deodorised, by means of the poudrette coke (the residue left in the retorts), and can be carried in carts or open vessels to the carbonising apparatus. In order to obtain an extra quantity of gas for heating the furnace, I purpose either making the retorts reciprocating, or using double retorts, with mouth-pieces, lids, and ascension-pipes at both ends; by this means, the charge of one retort, or of half a double retort, can be so arranged that the steam first given off will pass through and over the incandescent poudrette coke lying in the other half, or in the reciprocating retort, as the case may be. By this means, the steam becomes decomposed and forms two gases, hydrogen and carbonic oxide. There must be stop-valves in the ascension-pipes to carry out this arrangement. I have always insisted that the poudrette coke, surcharged with ordine, will give a highly-luminous gas. I am now preparing a project for the conservancy of the Cantonment of Dum-Dum, by order of the Viceroy in Council, and will send you full particulars of the result.

It may be thought that if the carbon be used to make carbonic oxide by decomposing the water, it will not be available for poudrette coke for deodorising fresh filth; but one, or a pair of retorts, loaded and so used, out of a group of five, will give sufficient gas for heating the furnace. For Dum-Dum, I propose having a group of five retorts (double), with a furnace-grate for coke at one end and a pipe passing in for gas at the other end through the back wall. There is a condenser, with a tank for collecting the tar and ammoniacal liquor; a dry-lime purifier, for getting rid of any carbonic acid; and a small gas-holder, for regulating the supply of gas to the furnace.—I am, &c.,

W. R. Gilbert Hickey, C.E.

Calcutta, Feb. 1st, 1870.

Manufacture of Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—With your correspondent Mr. Gibbins I saw the objections to Dr. Hofmann's improvement in the manufacture of sulphuric acid. Still the advantages to be derived from it, especially in the present condition of the nitrate market, are so large that I at once decided on giving it a fair trial, and am now arranging my vitriol chamber so as to obviate one of the difficulties named by your correspondent, and which, if not provided for, would probably be fatal.

The description will, probably, explain my object:—I have, say, six vitriol chambers at work, nearly all of large sizes; into No. 1 I work one set of furnaces and into No. 2 another set. The gases from No. 1 and from No. 2 meet in No. 3; this and No. 4 I shall work up to 1·715 specific gravity—Nos. 1 and 2 will work at 1·45; all the acid produced in No. 3 will be passed into No. 1 and all produced in No. 4 into No. 2: the acid of 1·715 as it mixes with that of 1·45 will give up its nitric oxide, which thus at once becomes again available and the acid can then be run off for use from Nos. 1 and 2 in ordinary condition. The strong action having taken place in Nos 3 and 4 I shall work 5 and 6 at a lower strength in order to ensure condensation. I shall thus I hope reduce Dr. Hofmann's very valuable suggestion to a rather more practical shape, and if I can by even partial success save, say, a couple of tons of nitrate of soda per week, I shall gladly renew my chambers a year sooner than would otherwise be needful.—I am, &c.,

Peter Spence.

Pendleton, Alum Works, Manchester,
March 21, 1870.

Action of Iodine on Hyposulphite.

To the Editor of the Chemical News.

Sir,—In a paper by C. R. A. Wright, published in the Chemical News (vol. xxi., p. 103; *Am. Rep., May*, '70, *page* 247), reference is made to a paper "On the Estimation of Manganese," published in the Chemical News (vol. xx., p. 302; *Am. Rep., Feb.* '70, *page* 82), in which the authors say:—"In estimating the manganese by the method of Bunsen, the iodine liberated by the chlorine should be tested as soon as possible after the decomposition," the iodine solutions in each of two experiments requiring an amount of hyposulphite corresponding to 62·7 per cent of available peroxide in the manganese ore assayed, when tested immediately after the decomposition, and to over 65 per cent after standing twenty-four hours. "This was caused by the conversion of iodine into hydriodic acid."

In a note published in the Chemical News (vol. xxi., p. 48; *Am. Rep., March* '70, *page* 176), and which seems to have escaped Mr. Wright's notice, the following explanation of this is given:—

"These higher results are caused by the liberation of iodine by spontaneous decomposition of hydriodic acid set free by hydrochloric acid distilled over during the process, as the following experiment shows:—A few drops of hydrochloric acid were added to a solution of iodide of potassium. The solution remained for some hours colourless, but, after standing twenty-four hours, had become quite yellow, and was found to contain free iodine sufficient to indicate 3 per cent of peroxide of manganese when titrated with hyposulphite.

Mr. Wright's experiments, though very interesting, do not in the least "account for the results obtained by Messrs. Sherer and Rumpf," since the conditions were not identical.—I am, &c.,

Edward Sherer.

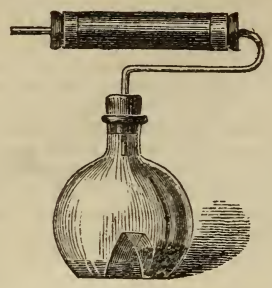
4. St. Nicholas Buildings,
Newcastle-on-Tyne, March 21st, 1870.

LABORATORY NOTES.

NEW APPARATUS FOR THE ANALYSIS OF CARBONATES.

So many forms of apparatus for the analysis of carbonates have been devised that it is just possible the one which is shown in the engraving may have been already suggested. In Griffin's "Chemical Handicraft," sixteen kinds of apparatus for this purpose are described, but not one of them is of so simple a construction as that which I propose. Fritzsche's is almost as simple as mine, but it is not so manageable.

My apparatus is a light bottle, of the capacity of 75 centimetres. The lower part is divided into two compartments; in one of which the carbonate is placed, in the other the



acid. By inclining the bottle, the acid may be allowed to flow over on the carbonate as gradually as the operator pleases. One or two chloride of calcium tubes are inserted through the cork. The cost of this bottle would be about 6d.

Charles A. Cameron, M.D.,
Analyst to the City of Dublin, &c.

MISCELLANEOUS.

Chemical Society.—The following is the Council's list for the election of officers on March 30th, 1870:—President—A. W. Williamson, Ph.D., F.R.S. Vice-Presidents who have filled the office of President—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., V.P.R.S.; Lyon Playfair, M.P., Ph.D., C.B., F.R.S.; Col. P. Yorke, F.R.S. Vice-Presidents—E. Frankland, Ph.D., F.R.S.; J. H. Gilbert, Ph.D., F.R.S.: A. Matthiessen, Ph.D., F.R.S.; H. M. Noad, Ph.D, F.R.S.; W. Odling. M.B., F.R.S.; T. Redwood, Ph.D. Secretaries—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S. Foreign Secretary—H. Müller, Ph.D., F.R.S. Treasurer—F. A. Abel, F.R.S. Other Members of Council—E. Atkinson, Ph.D.; H. Bassett; E. T. Chapman; David Forbes, F.R.S.; F. Field, F.R.S.; Dr. M. Holzman; E. J. Mills, D.Sc.; W. J. Russell, Ph.D.; Maxwell Simpson, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; A. Voelcker, Ph.D.

Flower Farms—Premiums for Odours of Plants.—The following premiums have been placed at the disposal of the Council of the Society for the Encouragement of Arts, Manufactures, and Commerce, for the term of seven years, by Dr. Septimus Piesse, F.C.S.:—1. A premium of £5, for one pound of otto of bergamot, of the value of 16s. or more in the London market, being the produce of plants (*Citrus Bergamia*) grown in Australia, New Zealand, Natal, any of the British West India Islands, or any other British Colony or Dependency. 2. A premium of £5, for 1 oz. of otto of roses, of the value of £1 or more in the London market, being the produce of any variety of roses grown together in one plantation in the above-mentioned Colonies. 3. A premium of £10, for a canister of enflowered butter or fat, so scented with any kind or sort of flower, either by infusion or enfleurage, or by means of these processes jointly, of the weight of 3 lbs. or more, and of the value of 6s. per lb. in London; the said butter or fat to be enflowered or infused with flowers grown for the purpose in the British Colonies.

On the Use of Ether as an Intoxicant in the North of Ireland.—We have received from Mr. H. N. Draper a pamphlet on the above subject from which we learn that the use of methylated ether instead of alcohol is very general in the counties of Londonderry, Antrim, and Tyrone. The quantity taken at one time is from two to four drachms and the dose is repeated twice, thrice, or even four and six times daily. Mr. Draper treats the subject in its relation to the Inland Revenue and also to insurance companies, the former suffering by the practice to the extent of £5666 per annum, while the risks of the latter are increased by such an inflammable liquid being stored and handled by people ignorant of its properties.

Water Supply of London.—We have received from Dr. Letheby his report on the sanitary condition of London, in which he says the chemical composition of the metropolitan water has not fluctuated to any considerable extent; for that derived from the Thames and the Lea has contained from 21 to 23 grains of solid matter per imperial gallon during the winter months, when the rainfall is the greatest, and from 17 to 17·5 grains per gallon in the summer, when it is least, the average for the whole year being about 19·3 grains per gallon, of which about 14·2 grains are calcareous salts, giving that degree of hardness to the water, the hardness being reduced to about 3·8 degrees by boiling the water for a quarter of an hour. The proportion of common salt in the water does not exceed 1·8 grains per gallon, and the organic matter, as estimated by the oxygen required to oxidise it, is not above two-thirds of a grain per gallon. The nitrogenous matter also is remarkably small, ammonia being in the proportion of only one part to about 35,000,000 parts of water, and the nitrogen, as nitrates, &c., as one to 630,000 parts. The water supplied to the public is for the most part clear and colourless; on one occasion, however, during the year, it was slightly turbid in the case of the Grand Junction water; on two occasions with the Southwark and Vauxhall water; on four with the Lambeth; and on six with the Chelsea. The daily supply of water to the metropolis has ranged from 91,578,341 gallons per day, in the month of January last, to 110,094,058 gallons in the month of July, the average for the whole year being rather more than 99,000,000 of gallons per day, or 31·2 gallons per head of the population. The daily supply to Paris averaged 46,561,472 gallons per day, or 24·6 gallons per head of the population; but this includes the water supplied to the public fountains, ornamental waters, &c. The number of houses supplied daily by the water companies of London is about 463,000. Rather more than half of the water is obtained from the River Thames at Hampton, and the rest is from the Lea, and from springs and wells in the chalk. The supply to Paris is derived chiefly from the Canal d'Ourcq and the River Seine. None of the Paris water is filtered, and is always more or less turbid when it reaches the consumer. In London, however, the water is filtered, generally in a very effective manner. It is remarked that, except in special cases, water of moderate hardness, like that supplied to the metropolis, to Paris, and Vienna is always preferred, and is best suited for domestic purposes, because of its being brighter to the eye and more agreeable to the taste. So satisfied, indeed, were the French authorities on this head, that they passed by the soft waters of the sandy plains near Paris, and went far away to the chalk hills of Champagne, where they found a water which is even harder than that supplied to London. One important consideration which strongly influenced them in their decision was the fact that more conscripts are rejected in the soft water districts, on account of imperfect development and stunted growth, than in the hard; and they conclude that calcareous matter in water is essential to the formation of tissues. In this country, also, it is remarkable that, wherever soft water is supplied to the people, the mortality is large, even when allowance is made for the birth-rate of the place. Glasgow, for example, as well as Preston, Dundee, Sheffield, Plymouth, Manchester, Bradford, &c., which are all supplied with water of less than 4 degrees of hardness, have a mortality which ranges from 26 to 34 per 1000, while at Birmingham, Bristol, Sunderland, Newcastle-on-Tyne, Wakefield, Dover, Norwich, Croydon, Worcester, Derby, and other places, where the waters are hard, the mortality is considerably less; in fact, it may be said that in towns supplied with water of more than 10 degrees of hardness, the average mortality is about 22 per 1000, while in those supplied with softer water it is about 26

per 1000. It may well be, as the late Professor Johnson observed, that "the bright sparkling hard waters which gush out in frequent springs from our chalk and other limestone rocks are relished to drink, not merely because they are grateful to the eye, but because there is something exhilarating in the excess of carbonic acid they contain and give off; and because the lime they hold in solution removes acid matters from the stomach, and thus acts as a grateful medicine to the system. To abandon the use of such a water, and to drink daily in its stead one entirely free from mineral matter, so far from improving the health, may injure it. The water of a country may determine the diet of its inhabitants. The soft water of the lakes of Scotland may have had much to do with the use of brown meal; and but for the calcareous waters of Ireland the potato could not have become a national food." Looking at the plain teachings of all this, and considering the excellent quality of the water supplied to this metropolis, it would be folly, in my opinion, to change it for a soft water. On the other hand, it is quite possible to have an excess of calcareous and other saline matters, as is the case with the well waters of this city, where the proportion ranges from 48 to 120 grains per gallon. Dr. Letheby concludes with a report of the sanitary work done in the city during the year.

The Royal Society.—The president gave the first *soirée* of the season on Saturday evening last at Burlington House. There was a large attendance of visitors, and a number of objects of scientific interest were exhibited. Mr. Browning's display included an improved large automatic electric lamp, in which the carbon points are drawn asunder, and their distance regulated solely by the force of the electric current employed; transparent stereograms on glass, of a globe of the planet Mars; water-colour drawing of Jupiter, exhibiting the ochreish-yellow or tawny belt, now visible near the equator of the planet; arrangement of spark condenser, in connection with a condenser in box to take the Leyden jar, the upper part to unscrew and pack in lid of box—the advantages are perfect insulation, large surface in small space, freedom from liability to fracture, portability; bright cross micrometer for measuring the position of lines in faint spectra; by using this instrument only the cross is seen illuminated, and the light of the spectrum is unimpaired; spectrum of pure gold, shown in a chemical spectroscope, this instrument has been arranged specially for use in a laboratory, the prism is provided with a very closely fitting cover, and the prism can be removed from the plate and a prism of any other substance introduced instead, for the convenience of taking refracting indices and dispersive powers. The India Rubber Company showed the Leclanché battery. The vacuum tubes shown by Mr. Apps attracted considerable attention. Mr. Ladd showed his new form of electric lantern recently described in these columns. This maker also showed a new form of micro-spectroscope. Mr. W. Chandler Roberts, the chemist to the Mint, exhibited remarkable specimens of electro-deposited iron, prepared by M. Jacobi, of St. Petersburg, and himself. The metal is sufficiently hard to scratch glass. The application of hard iron plates for printing purposes was illustrated by some extremely fine proofs. This material possesses great advantages as an art material. Specimens of electro-iron converted into steel were also shown.

Death of Dr. Redtenbacher.—We regret to have to announce the death of Joseph Redtenbacher, M.D., &c., Professor of Chemistry at the University of Vienna. The deceased was born on March 12th, 1810, at Kirchdorff (Austria), and held, since 1849, the Chair of Chemistry just alluded to. He was well known as the author of a large number of scientific memoirs and papers, and was a member of the Imperial and Royal Academy of Vienna from the date of its foundation, some forty years ago.

New Dictionary of Science.—Messrs. Moxon and Co. are preparing for publication a Dictionary of Science, edited by Mr. G. Farrer Rodwell. It will be uniform with Haydn's 'Dictionary of Dates" and "Dictionary of Biography," and will comprise—Acoustics, Astronomy, Chemistry, Dynamics, Electricity, Heat, Hydrodynamics, Hydrostatics, Light, Magnetism, Meteorology, Pneumatics, Statics. These subjects will be treated of by—J. T. Bottomley, M.A., Lecturer on Natural Science in King's College School; William Crookes, F.R.S., &c., Frederick Guthrie, B.A., Ph. D., Professor of Natural Philosophy in the Royal School of Mines; R. A. Proctor, B.A., F.R.A.S.; Richard Wormell, B.A.; and the Editor.

Gold-Smelting in Irkoutsk, East Siberia.—MM. Basnin and Lomonossoff have opened a private laboratory, in Irkoutsk, for the technical study of the minerals, &c., of the country—*i.e.*, the determination of ores, salts, solutions, manures, and materials for building and heating (the determination of paraffin in asphaltum is included). The laboratories are large, and fitted up with all the necessary apparatus. The titration method will be exclusively used for technical analysis of useful minerals; as far as this method extends, MM. Lomonossoff and Basnin have promised to send us an account of the results of their labours from time to time.

A Soda Mine.—Some two miles north of the Sand Springs Road, and fifty miles east of Virginia and Gold Hill, is an immense and apparently inexhaustible deposit of almost pure soda. It is owned by parties in Carson and Virginia, who use it in the manufacture of soap, and also supply quartz mills with it as a chemical agent in the reduction of ores. They also supply it to drug and grocery stores, where it is sold for washing and other proposes for which common soda is ordinarily used. It is free from all earthy matter, and consists of 80 per cent soda, the balance being salt, or something of the sort. The deposit is in the midst of an alkali flat, of some 17 acres in extent, and at the surface it appeared only about 3 feet wide, or rather more like a soda spring than anything else, the pure article forming in a crust over and about the strong watery solution. Upon digging beneath this, however, the solid soda was discovered in a defined mass, like a quartz ledge. A shaft has been sunk beside it to the depth of 50 feet, from the bottom of which a drift has been made 25 feet into the vein or deposit of soda, without getting through it; in fact, very little is known of the depth or extent of this huge deposit of soda, except that there is apparently a million tons or more of it in sight. The enclosing walls on each side are very distinctly defined, and are simply composed of a dark, heavy, compact, iron sand, strongly impregnated with soda. This deposit is as singular as it is valuable, and goes to show how little the varied and inexhaustible resources of our young State are as yet developed.—*Gold Hill News.*

Manufacture of White Lead.—An invention is at present being tested by which ordinary galena, after having been crushed in an ore crusher, is roasted in a desulphurising kiln, and next mixed with carbon (preferably in the state of fine-washed pea or dust anthracite coal) in the proportion of half and half. This mixture is heated in a peculiarly-constructed furnace; and the dense white vapours which are given off are conveyed into a separate chamber, and strained, by passing through bags or screens of muslin, or are allowed to deposit slowly, and, after cooling, collected, as in the case of the manufacture of zinc-white.

Science in the Nineteenth Century!—The following advertisement, taken from the pages of a contemporary, is too good a joke to be lost:—"British Science having been for some time suspected of owing much of its reputation to the indifference of the general public on philosophical subjects, the truth or accuracy of which it has had no special means of acquiring practical information, or has been more or less blinded by an overweening confidence in the supposed skill of paid officials or royal Professors, several gentlemen have made it their business, at a great cost of time and labour, to investigate the grounds on which the various Astronomical and Geographical Societies have based many

of their principal theories. The *assumed* convexity or curvature of the earth's surface is found to be as gross a delusion as its supposed orbital and axial motion;—That it is nothing but a stationary plane of hill and dale and level, over the face of which the sun and moon and stars revolve; that Ptolemy and the ancient Greek philosophers were the only truthful and trustworthy authorities on matters of astronomical science, and that the later theories of Galileo and Sir Isaac Newton are directly contrary to Scripture, to reason, and to the positive evidence of our senses. Those who require or are disposed to accept further particulars, are requested to communicate with ——, enclosing Three Stamps, for pamphlets and postage; with lists of larger works on this subject. Literary and Philosophical Societies will do well to disabuse their minds of the impression that they can much longer resist and resent the growing demand for a thorough revision and re-construction of their antiquated and erroneous systems."

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half-yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Bayerisches Industrie und Gewerbeblatt, September to December, 1869.

The greater portion of these numbers is occupied by the publication of laws and other official matters relating to Bavaria. Among these, we meet with very complete and well got up instructions for the inspectors of weights and measures in consequence of the introduction of the decimal system. A large portion of these numbers is devoted to regulations relating to technical instruction, which is carried out to a very high degree in this kingdom.

Application of Heat to Mechanical Labour.—Dr. Linde.—A valuable contribution to the better utilisation of heat to be converted into mechanical force.

Technical Application of Coke obtained from Peat.—Dr. Vogel.

The More Recently Discovered and Valuable Metallic Alloys.—Dr. Fürtenbach.—This very lengthy paper is an excellent compilation on this subject.

Comptes Rendus des Séances de l'Académie des Sciences, February 14, 1870.

This number contains the following papers relating to chemistry and allied sciences:—

Galvanic Element with Three Fluids. — F. Zaliwski.—This contrivance consists of two porous cells placed one inside the other and surrounded by another suitable vessel. The inner vessel contains nitric acid and a piece of carbon; the intermediate vessel contains sulphuric acid; and the outer vessel a solution of sal-ammoniac in water and a piece of zinc. The author states that this arrangement is very superior to a Bunsen cell.

Accidental Images of White-Coloured Objects.—J. M. Seguin.—A continuation of a former paper on this subject.

Geological and Agronomical Map of the Department de la Haute-Vienne.—J. Mallard.—M. Elie de Beaumont calls the attention of the meeting to this map, on account of the excellent manner in which it has been executed by means of chromo-lithography. The description given is too lengthy for full reproduction here; but the utility of such local maps, executed with minute accuracy and on a large scale, must be evident.

Fusion of Platinum.—Dr. St. Claire-Deville states that an error has accidentally been made in the *Compte Rendu* of the last meeting, and that it is the oxygen, not the hydrogen, dissolved during the fusion of platinum, which gives rise to this metal, presenting the same phenomenon as molten silver—viz., scintillation and spirting while in the molten state.

New-Electro-Magnetic Apparatus.—A. Demoget.

Description of an Apparatus for Registering, by Photography, the Reading of the Barometer.—P. Volpicelli.

Historical Notes on the Radiation of Heat from the Moon.—P. Volpicelli.—After referring to the opinions of Virgil, Dante, Tasso, Marini and Guarini, who denied the possibility of heat emanating from the moon, the author quotes, from the works of Aristotle, Aquino, Pic de la Mirandolle, and Cardan, who, although not enabled to prove, experimentally, any facts relating to this matter, yet admitted that heat emanated, to some degree, from the moon. Dr. Hooke was the first who called attention to this subject, by some observations and experiments; and Geminio Montanori (born, 1632; died, 1687) states, in his "L'Astrologia Convinta di Falsità," that the heat emanating from the moon can be readily made perceptible by means of a large air thermometer and a powerful lens. In our days, the author says, it was Melloni who, on the 23rd of March, 1846, has incontrovertibly proved, by experiments, that the moon radiates heat.

Double Crystals Exhibited by Snow.—J. Girard.

Action of Green Light upon the Mimosa Pudica.—P. Burt.—The plants are placed under glass jars constructed of variously-coloured glass. The chief fact observed in respect of these very sensitive plants is that, by being covered with a green-coloured glass jar, the plant rapidly becomes insensible, and dies in a very short time.

Solar Spots Visible by the Naked Eye.—Tremeschini —By simply making use of a coloured glass, the author states that these spots can be seen very well; the diameter of the largest was, on the 11th instant at 9 a.m., 0° 3·45′, and on the 14th at 10 a.m., 0° 4·50′.

By far the greatest portion of this number is occupied by essays on geometrical, mechanical, and mathematical subjects; and there is no paper strictly relating to chemistry.

Journal für Praktische Chemie, No. 16, 1869.

This number contains no original papers.

No. 17, 1869.

On the Lead Salts of Formic Acid.—Dr. Barfoed.—The author describes:—Neutral formiate of lead.—According to what is stated on the solubility of this salt in treatises on chemistry, it is soluble in 36 parts of water; but, according to the author's experiments, this salt, prepared with proper care, requires for solution 63 parts of cold water, while it requires 5½ parts of boiling water for solution. This salt is, moreover, gradually decomposed by being boiled; formic acid escapes, and a basic salt remains. Bibasic formiate of lead is obtained when an aqueous solution of the neutral salt is treated with its equivalent weight of oxide of lead; it is readily obtained in large crystals, which are, however, easily acted upon by the carbonic acid of the air. The formula is $2PbO,C_2HO_3$. 1 part of this substance requires 58·5 parts of cold and 10 parts of boiling water for solution; it is insoluble in alcohol, as is likewise the neutral salt. Tribasic formiate of lead is obtained by boiling a solution of the neutral salt with two equivalents of oxide of lead; this substance is obtained in small acicular

crystals, soluble in 25½ parts of cold, and 7½ of boiling, water; formula, $3PbO,C_2HO_3$. Quadribasic formiate of lead, $4PbO,C_2HO_3$.—1 part of this salt requires 104 parts of cold water for solution; it is insoluble in alcohol.

Estimation of Nitric Acid in Spring Waters.—Dr. Fleck.—The method, described at great length, is based upon the fact that, according to the author, the nitric acid present in spring waters is chiefly combined with lime or magnesia, and rarely only with alkalies. Use is made of the well-known fact that a solution of sulphate of potassa yields, when mixed with a solution of nitrate of lime, gypsum and nitrate of potassa, which, in its turn, when ignited in the presence of organic substances, is converted into carbonate of potassa; while, lastly, the carbonate of potassa thus formed can be quantitatively estimated and is proportional to the quantity of nitric acid present. The reagents required for the execution of this method are—Normal nitric acid and normal caustic soda solution, each at from 4 to 5 per cent; a solution of sulphate of potassa, 5 grms. to 100 c.c. of water; perfectly pure sugar. According to the statements made in this lengthy essay, this method appears to be a useful addition to quantitative chemical analysis.

A New Salt from Hallstadt (Austria).—Dr. Simony.—This mineral occurs along with rock-salt, anhydrite, and a somewhat weathered sulphate of soda; its colour is bluish green; formula, $MgSO_4,Na_2SO_4,4H_2O$. This salt is not affected by exposure to air, and loses, even at 100°, only a portion of its water. Although, therefore, this salt has the same percentage composition as astrakanite, it has a different constitution. The three now known naturally-occurring double salts of the sulphates of soda and magnesia are, therefore—

$MgSO_4.Na_2SO_4,4aq$, astrakanite, or Bloedite;

$2MgSO_4,2Na_2SO_4,5H_2O,3aq$, Simonyite (the salt just discovered);

and $2MgSO_4,2Na_2SO_4,5H_2O$, Loewite.

Synthesis of Hydroxylamine.—Dr. Ludwig.—The author has succeeded in directly combining nascent hydrogen and deutoxide of nitrogen, $NO+H_3=NH_3O$. This is effected by passing pure deutoxide of nitrogen through a mixture of tin and hydrochloric acid; the tin is removed by sulphuretted hydrogen, the filtrate is evaporated to dryness, and the residue taken up with alcohol. The chloride of ammonium is removed by chloride of platinum, and the hydroxylamine is precipitated with pure anhydrous ether.

Action of Chlorine upon Absolute Alcohol while Exposed to Direct Sunlight.—MM. Streit and Franz.—While engaged in making hydrate of chloral with absolute alcohol, direct sunlight accidentally fell upon the apparatus, the temperature of the contents of which was 62°. The continued action of the sun's rays caused a series of sharp detonations, accompanied by very bright lightning-like flashes inside the apparatus; the fluid, previously quite clear, became black, a blackish powder was separated, and the temperature rose to 78°. The authors repeated the experiment with artificial light, and found that magnesium light, the light emitted by a mixture of sulphide of carbon and deutoxide of nitrogen while burning, electric light, and the light emitted by the ignition of a mixture of chlorate of potassa and sulphur, when ignited produce the same effect. The products of the decomposition of the alcohol were not further investigated, but exhibited a most frightful stench and a deep reddish brown colour.

Revue Hebdomadaire de Chimie, February 10, 1870.

Process for Rendering Various Substances Waterproof.—M. Ch. Toppan.—This contrivance consists, essentially, in the employment of a solution of pure paraffin in naphtha—that is to say, light petroleum oil—and to steep the objects required to be waterproof in this solution.

Estimation of Starch in Bread.—J. Mayer.—The method proposed by the author is that of converting the starchy matter into glucose, by means of boiling, say 5 grms. of the bread, with water containing 1-20th of its weight of sulphuric acid. The liquid is kept boiling for a considerable time, and from time to time a small quantity is tested with iodine; when, as the latter substance fails to indicate the presence of starch, the ebullition is kept up for some time longer, and the glucose which is formed is estimated by Fehling's process. A too weak acid should not be applied, nor, also, a stronger, as both are, according to the author, equally injurious to the accuracy of the results.

On Diamonds.—M. F. Rambosson.—This paper, an abstract of a printed book just published, is accompanied by an engraving representing the most celebrated of these precious stones. No mention is, however, made of the largest diamond ever yet found, which once belonged to the Rajah of Mattan, Borneo, but is now in the possession of the Netherlands' Government; this jewel, as yet uncut, however, has a flaw (a very common thing for large diamonds—for instance, the Koh-i-noor), which very materially impairs its value. This stone weighs 367 carats (upwards of 3 ozs. troy), and is egg-shaped.

Bromoform, Bromal, and Iodal compared with Chloroform and Chloral.—Dr. Rabuteau.—This paper is the record of some experiments made with these substances to test their anæsthetic value.

Cosmos, February 12, 1870.

Imperial Observatory at Paris.—By the same decree which relieves M. Le Verrier from his functions as Director of the Observatory, the provisional management and chief control of that establishment is placed in the hands of a committee of three gentlemen—viz., Vice-Admiral Penhoat; M. Combes, Member of the Institute; and M. Balard, Inspector-General of Superior Public Instruction.

Explosion of a Dynamite Manufactory.—This took place at Dunwald, near Cologne, a few days ago. The quantity of material exploded was only about 100 kilos.; but the destruction of life and property for a great distance around the spot was such as could hardly have been affected by thirty times as much gunpowder.

Dangers of Arsenical Green Pigments.—The Prefect of Police of the Seine (Paris and environs) has very properly issued a notice calling attention to the great danger attending the use of these pigments for imparting colours to the edges of books and various articles of stationery, to which these, specifically, very heavy materials are merely fixed, either by thin glue-water or gum. It is a well-known fact, the police notice says, that, even when mixed with linseed oil, these pigments are liable to become loose and pulverulent (unless peculiar precautions be taken); and they are altogether unsuitable for the purposes just named, since they dust off, and thus may be inhaled and cause derangements of health. The manufacturers of the articles alluded to are, if they continue this practice after this day, amenable to legal proceedings, correctionally as well as *en matière civile* (liable for action for damages).

February 19, 1870.

University of Heidelberg.—This, the most ancient of Germany except the Universities of Prague and Vienna, was founded in 1386, and has always been a first-rate establishment and of high standing in physical science. Helmholtz, Bunsen, Kirchhoff, Hofmeister and others have been and are among the bright gems of this scientific institution, which has a teaching staff of 80 men and an average number of from 400 to 600 students.

Rendering Tissues Waterproof (Impermeables).—V. Meunier.—1 kilo. of alum is dissolved in 32 kilos. of water, and 1 kilo. of acetate of lead is dissolved in the same

quantity (separately) of water. The two liquids having been mixed, there is, of course, precipitated sulphate of lead; as soon as this is deposited, the clear liquid is decanted, and the fabric which it is desired to render waterproof is thoroughly steeped in this fluid, and next dried by being hung up in open air.

Moniteur Scientifique, No. 316, February 15, 1870.

This number contains the following original papers and memoirs pertaining to chemistry:—

Peat from Avigliana, near Turin, Italy.—Dr. Fino.—Close to the Mont Cenis railway tunnel, in the valley of Susa, an enormous deposit of peat is found which, since fuel of any kind for industrial purposes is scarce all over the Italian soil, is largely used. The authors have analysed four different samples of this fuel, viz.:—The top layer, or light peat, containing, in 100 parts—Water (driven off at 100°), 44·19; volatile combustible matter, 36·44; coke, 16·44; ash, 2.93. Middle layer—Water, 38·10; volatile combustible matter, 36·09; coke, 20·89; ash, 4·92. Lower layer, compact black peat—Water, 32·41; volatile combustible matter, 36·23; coke, 21·22; ash, 10·14. Artificially-compressed very hard black peat—Water, 26·89; volatile combustible matter, 38·38; coke, 22·41; ash, 12·32. The average composition of the ash of these peats (containing, on average, after drying, 11·37 per cent thereof) is, in 100 parts—Silica and clay insoluble in HCl, 37·61; silica soluble in HCl, 0·85; protoxide of iron, 5·30; peroxide of iron, 10·22; alumina, 7·0; lime, 24·61; magnesia, 1·40; sulphuric acid, 3·04; traces of HCl, KO, NaO, and loss, 0·61; carbonic acid 0·36. The utilisable calorific value of sample 1, in wet state, is 1836; No. 2, 2172; No. 3, 2391; No. 4, 2515.

Mineral Magnesian Water from Bertinaro.—M. F. Sestini.—When recently taken from the spring, this water is perfectly limpid, and keeps so in well-corked bottles. When exposed for some time to the air, a white sediment is deposited; taste, bitter saline; exhibits a slight hydrosulphuric odour; does not affect litmus paper, but reddens turmeric paper slightly. 1 litre of the water contains—Chloride of magnesium, 1·71 grms.; chloride of sodium, 7·027; chloride of potassium, a trace; sulphate of soda, 0·368; sulphate of lime, 0·639; bicarbonate of lime, 1·83; alumina, ferrous oxide, and phosphoric acid, 0·016; silica, 0·012; organic matter and ammonia, 0·746;—total, 12·348 grms.

Ammonia Gunpowder.—M. A. Jouglet.—The owners of the Nora-Gyttorp Powder Mills, Sweden, have brought out a new kind of powder, which contains, it appears, a mixture of nitrate of ammonia and nitrate of potassa (with what other substances is not said). This material is, according to some accounts, a more powerful explosive than nitroglycerine, and cannot be ignited, or made to explode, but by the impact of a blow, or a falling weight, or by the detonation of a small cartridge containing common gunpowder. Experiments made at a military establishment at Berlin with this powder have proved that, while ordinary gunpowder, gun-cotton, nitroglycerine, and dynamite take fire the moment flame is approached, this powder did not do so. As regards the effect of the impact of a blow of a falling weight (the same, of course, in each case), ordinary gunpowder requires for explosion that the weight falls from a height of between 4 and 5 ft.; nitroglycerine, 1½ ft.; dynamite, 2¾ ft.; and ammonia gunpowder, between 12 and 15 ft. A sample having been sent to France from Berlin did not, the author says, confirm the high opinion this substance is thought worthy of in Prussia.

Waterproofing Paper.—M. A. Jouglet.—The solution of oxide of copper in ammonia acts, as is well known, as an energetic solvent upon cellulose; this property is made use of to waterproof paper in the following manner:—A tank is made to contain the solution just alluded to, and the paper is rapidly passed just over and in contact with the surface of the liquid, by means of properly-placed rollers moving with speed. The paper, on leaving, is pressed between two cylinders, and next dried by means of so-called drying cylinders, similar to those in use in paper mills. The short contact of the felty paper tissue with the liquid gives rise to just sufficient solution of cellulose to form an impermeable varnish.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, Vol. xiv., No. 3, 1869.

The only paper relating to chemistry in this number is a lengthy one:—

Chlorinated Derivatives of Toluol.—Drs. F. Beilstein and A. Kuhlberg.—The authors have divided their memoir into the following sections:—Isomeric tetrachlorotoluols—

$CH_6\ Cl_4.CH_3$, $C_6H_2Cl_3.CH_2Cl$, $C_6H_3Cl_2.CHCl_2$, and $C_6H_4Cl.CCl_3$;

isomeric pentachlorotoluols—

$C_6Cl_5.CH_3$, $C_6HCl_4.CH_2Cl$, $C_6H_2Cl_3.CHCl_2$, and $C_6H_3Cl_2.CCl_3$;

isomeric hexachlorotoluols—

$C_6Cl_5.CH_2Cl$, $C_6HCl_4.CHCl_2$, and $C_6H_2Cl_3.CCl_3$;

isomeric heptachlorotoluols—

$C_6Cl_5.CHCl_2$ and $C_6HCl_4.CCl_3.C_6Cl_5.CCl_3 = C_7Cl_8$.

There is added to this memoir an extensive tabulated review of all the compounds treated of, exhibiting their boiling-point, specific gravity, percentage composition, crystalline shape, melting-point of the solid substances and formulæ.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 20, 1869.

This number opens with a beautifully-executed and very good photographic likeness of the late lamented Thomas Graham, represented as he was known to us in the later days of his life. A full biography of the deceased, from the hand of his friend Dr. A. W. Hofmann, forms a conspicuous and valuable portion of this number, which contains the following original papers and communications:—

Various Reactions Exhibited by the Salts of Oxide of Copper (Black Oxide) when Cyanogen Compounds are Present.—Ed. Schaer.—This very lengthy paper is reserved for future communication in full.

Synthesis of Aromatic Acids.—Th. Zincke.—Referring to the observation of Dr. Wislicenus, that minutely-divided silver is one of the best means for the concatenation (verkettung) of carbon atoms, the author imagined that this might be also useful for the synthesis of aromatic acids. He describes, at very great length, his experiments, beginning with α toluolic acid, phenylo-acetic acid; but, instead of applying silver, use has been made of very minutely-divided copper. The ethyl-ether of the acid just alluded to was heated, along with bromide of benzol and copper, to from 180° to 200°, in a sealed tube. After a lengthy and complicated process of purifying, a sufficient quantity of pure material was obtained to test its properties, which are—A solid crystalline body, fusing at 76°, subliming at a higher temperature, without decomposition, and difficultly soluble in cold, but more readily so in hot, water. The analysis of the silver-salt and the products of oxidation by means of chromic acid, yielding carbonic acid and benzoic acid, prove the perfect identity of the substance as α toluylic acid Synthesis of phenyl-propionic acid.—The author thought that it might be possible to withdraw from monochloro-acetic acid and chloride of benzyl, the chlorine, by means of copper or silver, and to obtain an acid, C_6H_5,CH_2CH_2COHO—that is to say, β phenyl-propionic acid; but the results of a series of experiments did not confirm this view; and the body chiefly produced is a substance insoluble in alcohol, whether cold or hot, difficultly soluble in ether, and slightly better soluble in benzol, chloroform, and sulphide of car-

bon, from all of which solutions it is only obtainable as an amorphous, brittle resin, exhibiting, even in its dilute solutions, a bluish fluorescence similar to that exhibited by solutions of quinine. Energetic oxidising substances are, even at boiling heat, without any action upon this substance, which yielded, by elementary organic analysis, in 100 parts —C, 92·98; H, 6·72; formula, C_7H_6. When chloride of benzyl is diluted with twice its bulk of any hydrocarbon boiling at 130°, and then treated as above described, an aromatic oily substance is obtained, which the author reserves for further investigation.

Chlorocarbonate and Carbaminate of Phenol.—Th. Kempf.—Referring to his former researches on this subject, the author states that he has obtained a compound—

$$C_7H_7NO_2 = CO\begin{cases} H_2N \\ OC_6H_5 \end{cases}$$

fusing at 141°; soluble in water, alcohol, and ether; and yielding, on evaporation of these solutions, a crystalline substance; when heated to about 150° with a saturated solution of ammonia in water, phenol is formed, and urea.

Estimation of the Quantity of Sulphide of Carbon in Coal Gas.—A. Vogel.—The author first alludes to the great perfection the purifying process of coal gas has attained (at least, abroad, where gas-works are under very severe inspection, and especially so in the country this author hails from—viz., Bavaria), so that coal gas may be made to pass for several consecutive hours through a solution of a lead-salt without affecting it in the least. As to the presence of sulphide of carbon (which, by the bye, the author remarks, owes its formation very much to defective care, in respect of the temperature applied to the retorts, as well as to unsuitable selection of the qualities of coal), it can only be present in small quantity, and therefore its detection, as well as its estimation, become rather more difficult. The plan suggested and experimentally tested is the following, based upon the simple fact that, when pure metallic copper is in contact with gas containing sulphide of carbon, sulphuret of copper is formed:—Coal gas, purposely purified from every trace even of sulphuretted hydrogen, was caused to pass over bright metallic copper for several hours. The surface of the metal having assumed an iridescent hue, the copper was washed with dilute nitric acid; and a solution of a salt of barium having been added to this acid solution, a precipitate of sulphate of baryta was obtained after some hours' standing. It is, of course, absolutely required to use pure reagents, and insure the freedom of the copper from any sulphur.

Constitution of Isatine, Isatinic Acid, and Indol.—Aug. Kekulé.—This paper contains a lengthy hypothetical discussion on this subject in reference to the researches of MM. Baeyer and Emmerling and the author's own.

From the *procès verbal* of the annual general meeting of this Society, we learn that it now numbers 408 members—viz., 137 home and 271 foreign—including a great many Germans resident beyond the limits of the North Germanic Confederation. It has extended its correspondents to the chief countries of Europe and America, and possesses an already valuable library, while its financial position is all that can be desired.

Revue des Cours Scientifiques de la France et de l'Etranger, February 19, 1870.

This number contains an excellent paper—

Lecture on the Mechanical Forces.—M. A. Cazin; but no papers at all relating to chemistry.

The American Journal of Science and Arts, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Relation between the Intensity of Light produced from the Combustion of Illuminating-Gas and the Volume of Gas Consumed.—B. Silliman.—This lengthy paper contains valuable information on this subject, and a detailed description of a series of experiments made with a view to prove, among other matters, also this theorem—that the intensity of gas-flames (*i.e.*, illuminating power) increases, within the ordinary limits of consumption, as the square of the volume of the gas consumed. The chief point of interest for the consumer of gas to be deduced from the data here presented is that, where it is important to obtain a maximum of economical effect from the consumption of a given volume of illuminating-gas, this result is best obtained by the use of burners of ample flow.

Principles of Molecular and Cosmical Physics.—W. A. Norton.—A lengthy philosophical essay.

New Method of Separating Tin from Arsenic, Antimony, and Molybdenum.—F. Wigglesworth Clarke.—Reserved for full reprint at a future date.

Contributions to the Chemistry of Common Salt, with particular Reference to Our Home Resources.—C. A. Goessmann.

Account of a Fall of Meteoric Stones near Danville, Ala., with an Analysis of the Same.—J. Lawrence Smith.—This stone fell on Friday, November 27th, 1868, at about 5 o'clock p m., at Danville (about lat. 34° 30' N., and long., 87° W. of Greenwich). The iron, separated with great care from the pulverised meteorite, constitutes 3·092 per cent; and, on analysis, furnished—Iron, 89·513; nickel, 9·050; cobalt, 0·521; copper, a minute quantity; phosphorus, 0·019; sulphur, 0·105. The sulphide of iron, detached very carefully from the mass, gave—Iron, 6·11; sulphur, 39·56. The stony minerals, freed as much as possible from iron and pyrites, contained—Portion soluble in acid, 60·88; insoluble, 39·12. The latter, disintegrated and analysed, gave, in 100 parts—Silica, 50·08; alumina, 4·11; protoxide of iron, 19·85; magnesia, 20·14; lime, 3·90. The analysis of the soluble portion, owing to the unavoidable presence of a little iron and pyrites, furnished results, on analysis, that showed it to be mostly olivine. The soluble and insoluble matter as a whole (freed from pyrites and nickeliferous iron) gave, in 100 parts—Silica, 45·90; protoxide of iron, 23·64; magnesia, 26·52; alumina, 1·73; lime, 2·31; soda, 0·51; potassa, 0·64; sulphur, 1·01; and small quantities (not estimated) of oxides of manganese and chrome, phosphorus, and lithia; the latter detected by means of the spectroscope.

Annales des Mines, No. 5, 1869.

This number contains:—

Critical and Theoretico-Practical Examination of the Heaton Process.—M. L. Gruner.

Some Newly-Discovered and Proposed Processes for the Manufacture of Pig-Iron, Wrought-Iron, and Steel.—M. L. Gruner.

Researches on the Use which can be made of the Offal and Residues of Manufacturing Processes for Agricultural Purposes.—MM. E. Nivoit and E. Létrange.—We regret that we can only quote the sectional titles of this very interesting and lengthy memoir, which is filled with valuable information and a large number of chemical analyses. Residues from glue works; residues from beet-root sugar works; residues from the retting and peeling of flax; residues from breweries; gas-works residues and refuse; refuse from wool; residues and refuse from tan-yards; tallow-melting refuse; saw-dust and wood ashes; coal ash; some peculiar mineral ash (*cendres minérales*) from the Ardennes, and their application to mixing with liquid manure. In many instances, full directions have been given for the proper analysis and quantitative estimation of the materials spoken of.

Boring of Shafts by Kind-Chaudron's Method at Escarpelle.—M. J. De Boisset.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No 1, 1870.

This number contains the following original papers and memoirs:—

A Base Isomeric with Hydrocyanide of Ammonia (Cyanwasserstoff-Ammonia.)—H. Wichelhaus.—When orthoformic acid ether and acetamide are heated in a sealed tube for some hours to 180°, there is formed along with alcohol a white-coloured crystalline substance, the origin of which is explained by the following formulæ:—

$$CH(OC_2H_5)3+2C_3H_3O\cdot NH_2=3C_2H_6O+CH\left\{\begin{matrix}NH(C_2H_3O)\\N(C_2H_3O)\end{matrix}\right.$$

This substance is methenyl-diacetyl-diamine. Another product of this reaction is a substance the platinum salt of which is—

$$CN_2H_4,2HCl,PtCl_4;$$

while the base itself is CN_2H_4, termed by the author amidomethenylimide, and found to be isomeric with hydrocyanide of ammonia.

Terchloride of Iodine.—Jul. Philipp.—The terchloride of iodine does not behave with reagents as the other terchlorides do; treated with alkalies, it does not yield iodous acid (*jodige säure*), but iodic acid, while iodine is set free. This, according to the author, is due to the fact that ICl_3 is not a simple molecule, but a juxtaposition of ICl and Cl_2; and this is proved by the behaviour of the terchloride of iodine with reagents. These reactions are described at very great length, but space forbids to enter into more details.

Manufacture of Sulphuric Acid.—A.W. Hofmann.—The use of the nitric acid in the manufacture of sulphuric acid is to transfer the oxygen of the air on to the sulphurous acid; and, theoretically, therefore, a given quantity of nitric acid ought to convert an unlimited amount of sulphurous into sulphuric acid. That this is not obtained in practice can hardly be wondered at, since no manufacturing processes can be conducted absolutely without loss; but the loss of nitric acid in the manufacture of sulphuric acid, even when proper care is taken to ensure good working of the chambers, is so large that the inference is quite justifiable that there are peculiar chemical reactions at play. The study of these reactions has occupied the author, who states that, although he has not solved the problem entirely, he has obtained results worth communicating. When sulphurous acid is caused to pass into nitric acid which contains some sulphuric acid (sp. gr., 1·676 to 1·714), the nitric acid is converted into compounds which form, along with the sulphuric acid present, the so-called chamber crystals, without any perceptible formation of protoxide of nitrogen; but, when the nitric acid is impregnated with a sulphuric acid (sp. gr., 1·532), and the experiment just alluded to repeated, there is formed a considerable quantity of nitrogen, which is, of course, quite as injurious to the process as the presence and formation of protoxide of nitrogen. The explanation of this phenomenon is the insufficient strength of the sulphuric acid to form, in combination with the higher degrees of oxidation of nitrogen, the so-called chamber crystals. This having been ascertained, the author applied his knowledge of these facts in the following manner on the large scale:—The quantity of steam admitted to the first chamber (the so-called Tambour) was so regulated as to produce acid only at 60° Beaumé (sp. gr., 1·714 = 143° Twaddle), with the striking result, fully confirming the laboratory experiment, that a far smaller quantity of nitric acid was required for the same production of sulphuric acid. The author adds, that if, by accident, the strength of the acid in the aforesaid chamber should fall below the sp. gr. just alluded to, it can be easily brought up to that strength by the addition of acid of 66° Beaumé (sp. gr., 1·847) = 169 Twaddle. By this contrivance, it is possible to manufacture sulphuric acid with a consumption of only 1 lb. of nitric acid for 100 lbs. of sulphur burnt.

Derivatives from Guanidine.—F. Tiemann.—The author describes—Naphthyldiphenyl-guanidine—

$$C_{23}H_{19}N_3=\left\{\begin{matrix}IV\\C\\C_{10}H_7\\(C_6H_5)_2\\H_2\end{matrix}\right\}N_3;$$

naphthyltolylphenyl-guanidine—

$$C_{24}H_{21}N_3=\left\{\begin{matrix}IV\\C\\C_{10}H_7\\C_7H_7\\C_6H_5\\H_2\end{matrix}\right\}N_3;$$

diacetolylendiamine—

$$C_{11}H_{14}N_2O_2=\left\{\begin{matrix}C_7H_6\\(C_2H_3O)_2\\H_2\end{matrix}\right\}N_3;$$

and treats, at great length, of the preparation and complicated reactions by which these substances are obtained.

Ethyl Combinations of Thalium.—C. Hansen.—Thallium-diethyl-chloride, $Tl(C_2H_5)_2Cl$, a solid substance, soluble in boiling water, ether, and alcohol, is affected by light similarly to chloride of silver; slowly heated to 225°, it does not melt, but is charred; rapidly exposure to heat causes its instantaneous decomposition, accompanied by explosion, yielding a mixture of ethylen, ethylic hydride, and chloride of thallium; this decomposition ensues, therefore, according to the formula $Tl(C_2H_5)_2Cl = TlCl + C_2H_4 + C_2H_6$. Sulphothallium-diethyl, $(Tl[C_2H_5]_2)SO_4$, also a solid substance, crystallising in a foliated mass, soluble in water, ether, and alcohol. Nitro-thallium-diethyl, $Tl(C_2H_5)_2NO_3$, a solid body, very readily decomposable by heat.

Silico-Propionic Acid.—C. Friedel and A. Ladenburg.—A lengthy and exhaustive monograph.

Contribution to Explain Chemical Phenomena according to Mechanical Principles.—Dr. J.W. Gunning.

Appendix to the Researches on the Guaiacum Copper Reaction.—Ed. Schaer.—This is a supplementary part to the author's researches on this subject as detailed in the foregoing number of this periodical, but not suitable for abstraction.

Regressive Formations (Regressiv Bildungen) by Tri-Substituted Guanidines.—V. Merz and W. Weith.

Diamines Derived from *a* and *β* Dinitronaphthalines.—A. de Aguiar.—This paper, and the immediately foregoing, are too lengthy and too full of formulæ and diagrams to admit of any useful abstraction.

Researches on Xantho-Cobalt, Roseo-Cobalt, and Purpureo-Cobalt.—W. Gibbs.—The author states that, as an addition to his researches on xantho-cobalt, he has discovered the roseo- and purpureo-cobalt; the chloride of xantho-cobalt, $CO_2.(NO_2)_4.Cl+4NaCl$; chloride of purpureo-cobalt, $10NH_3.CO_2.Cl_6+4NaNO_2$. The memoir is an accumulation of formulæ, some of which are so lengthy that they occupy from two to four lines in print. The paper does not state anything about the origin or preparation of the substances, named along with several others.

Lecture Experiments.—J. Schoras.—(1.) *On Some Peculiar Actions of the Sun's Rays.*—When it is desired to prove the reducing action of oxalic acid upon metallic chlorides, it is a well-known experiment to boil a solution of chloride of gold to which oxalic acid solution has been previously added. The lecturer quotes, at the same time, another instance of this kind—viz., that a solution of chloride of mercury (corrosive sublimate), when treated in the same manner, is reduced to subchloride (calomel). When, during the lecture, this experiment is made too hurriedly, for the

ake of saving time, the only appearance seen is the feeble urbidity produced by the separation of a mere cloud of calmel; and, even if the boiling is continued for some time, t is readily seen that this reaction is not quite complete. When, however, a solution of perchloride of mercury is, after the addition of oxalic acid, exposed to the action of direct unlight, the copious precipitation of calomel ensues, after a ew minutes' exposure, in the shape of brilliant mother-of-pearl-like scales, which, illuminated by the direct sunlight hey are formed by, give rise to a beautiful phenomenon. If his sediment is collected, and dried at 110°, it will be found, on analysis, to contain 15·2 per cent of chlorine, thus proving t to be calomel. This experiment, and the undermentioned, can however, only be tried in our latitude when the sun is at its zenith, in July. When a solution of Berlin blue in oxalic acid is exposed to the direct rays of the sun, a sudden precipitation of Berlin blue ensues, and, instead of a deep-coloured, almost non-transparent fluid, a perfectly clear colourless liquid is exhibited. It is a well-known fact that solutions of the persalts of iron and uranium, to which oxalic acid is added, are, on being exposed to direct sunlight, converted to solutions of the protoxides of the metals, while carbonic acid is given off. The perchlorides answer best for experiments; a solution of perchloride of iron, to which tartaric acid has been added, is acted upon in a manner which is not quite explained. Such a solution is used in photography, in the so-called carbon process. A collodion plate, impregnated with the iron solution referred to, and dried in the dark, obtains, on exposure to light, the property of retaining, energetically, at the portions affected by the light, finely-divided substances—as, for instance, powdered black-lead, English red, finely-divided metals, and metallic oxides. The quantity of the powders thus adhering depends upon the greater or lesser intensity of the light which has fallen on it; and it is this condition which defines the various depths of hues and shades, and renders the stereometrical representation of the object possible. Photographers say that the action of the light has rendered the salt hygroscopic, and that this property causes the adhesion of the pulverulent substances. Whatever the action may be, the author states that a reduction process is in play. A solution of chloride of iron, to which tartaric acid had been previously added, and the colour of which was deep yellow, became, when exposed to direct sunlight, quite colourless; an evident proof that reduction had taken place. When a solution of peroxide of iron in tartaric acid is exposed to direct sunlight, a copious sediment of a crystalline yellowish green-coloured substance is thrown down. Since reduction takes place here on the one hand, oxidation must take place, of necessity, on the other; but it is not accompanied by any evolution of gas. The author reserves further study and experiments on this subject, which, as he very properly observes, may throw light upon many processes going on in animal and vegetable life. (2.) *Peculiar Phenomena of Colouration Exhibited by Some of the Platino-Cyanides.*—Gmelin was the first discoverer of potassium platino-cyanide; MM. Quadrat and Schafarik obtained similar compounds afterwards. We owe to Dr. Martins a valuable and exhaustive work on these substances and their composition. It is well-known that many of these salts are remarkable for a strong di- and tri-chroism; and this induced the author of this paper, while preparing a series of these salts, to make some very curious observations thereon, which are described as follows:—The calcium and magnesium salt of this series lose their water of crystallisation completely at a comparatively low temperature, and take it up again on cooling with great ease and rapidity. The anhydrous salts are white—the hydrated are coloured; therefore, paper and other suitable materials impregnated with solutions of these salts, become coloured. But a slight elevation of temperature is sufficient to decolourise them; and, on cooling, the colour reappears, in consequence of the more or less ease and rapidity wherewith the water of crystallisation is taken up. A slip of paper impregnated with a solution of magnesium platino-cyanide, exhibits, after drying, a beautifully bright red colour. A slight elevation of temperature is sufficient to render the salt anhydrous, and to temporarily destroy the colour entirely, which, however, reappears on cooling; while the re-taking up of the water may be aided by breathing over the paper. A slip of paper impregnated with a solution of calcium platino-cyanide exhibits, after drying, a bright canary-yellow colour; on being warmed, dehydration of the salt takes place, and, consequently, its complete decolouration; removal from the source of heat, accompanied by gentle breathing over the paper, is sufficient to restore the colour. When these experiments are made at night-time, magnesium light should be employed to render the true colours (especially the yellow) properly visible. The barium salt is also yellow-coloured, but is not so sensitive for the purpose as the calcium salt. When a mixture of the solution of the barium salt along with the potassium salt of this series is taken for the purpose of impregnating paper, that material exhibits, after drying, an unsightly yellow colour, which has the property of changing, by gently heating, from yellow to orange and red; and if the heat be increased, the original colour returns. While cooling, the piece of paper impregnated with the salt exhibits the phenomenon of passing through the same series of shades of different colours already alluded to—viz., yellow, orange, red, and again whitish yellow, the original colour. The lithium platino-cyanide is deliquescent, and hence unsuited for any experiments of a similar nature; the ammonium salt exhibits, while being evaporated to dryness on a porcelain basin, most curious brown-red colourations. The author suggests that if, while experimenting with these impregnated slips of paper in a lecture-room, any of them become ignited and burn to ash, this should be taken upon the feather of a quill, and immediately removed to a jar containing a mixture of oxygen and hydrogen (in the proportions to form water), and thus show the action of the spongy platinum left in the ash. The slips of paper impregnated with the calcium salt may, after having been previously decoloured by the application of heat, be very suitably applied for the detection of the least trace of moisture, since that has the effect of at once restoring the yellow colour. The author particularly points out that, since all the salts here spoken of are most violent poisons, they should not be used, or experimented with, but by parties who can be trusted with such matters; fortunately, also, the preparation is an expensive operation, as well as one requiring great skill and more knowledge than is common with those who usually undertake the preparation of chemical substances for sale as amusing toys.

Bulletin de la Société Chimique de Paris, January, 1870.

From the *procès verbaux* of the meetings of the Society we learn that M. J. Gautier gave a brief communication on the following questions:—Is the temperature at which two gases combine invariable? What influence is exerted by the products of their mutual reaction? What influence is exerted by any impurities purposely added? The author states that he is engaged in researches to answer these questions, and gave the following account of the results hitherto obtained:—A mixture of 2 volumes of hydrogen and 1 of oxygen having been made, this was exposed to incipient red heat, when it was found that union of the two gases takes place without being attended by any explosion. When heated by means of a Bunsen gas burner, union takes place instantaneously; and at an intermediate temperature between the first and last-named, union takes place rapidly, but without any explosion. Oxide of carbon unites with oxygen below red heat visible by daylight; chlorine and hydrogen, placed in absolutely opaque and sealed tubes, begin to form chlorhydric acid at 190°, and at 200° the combination becomes rapid. M. J. Friedel communicates that he has obtained oxide of amyl by heating, to 200°, amylic alcohol with one-tenth of its weight of iodide of amyl. The products of the reaction are—Water, amylen, amylic alcohol (mixed with some iodide of amyl and oxide of amyl; the

latter in quantity of about one-third of the alcohol employed. Dr. Prinvault states that, when he made bromine act upon protochloride of phosphorus, a brownish coloured oil was obtained, boiling at 75°; this liquid was found to consist of a fluid, $PBr_5+3ClBr$, and a solid substance deposited on cooling in prismatic crystals, $PBr_5+2ClBr$. When protochloride of phosphorus is made to act on bromine, a solid substance, fusing at 45°, and crystallising in oblique prisms, is obtained; formula, PCl_3Br_4. Heat decomposes these, yielding the protochloride and PCl_3Br_8.

The following papers and memoirs were read or deposited:—

Relation Existing between the Variation of the Crystalline Shape of Alum and the Menstruum it is Crystallised from.—E. Janettaz.—After referring to the labours of MM. Weber and Bendaut Lévy on this subject, the author describes a series of experiments made with the view of eliciting answers to the following questions:—Does the menstruum affect the composition of the crystals of alum? Are the isomorphus alums influenced in the same way by identical conditions? Is the action of acids isomorphous with hydrochloric acid the same? Supposing an alum to have been modified by hydrochloric acid, to be next dissolved by water, does the hemiedric condition remain? Is the complex form exhibited by these substances the result of all the bodies simultaneously in solution with them? Is any free acid required for the purpose of imparting to these substances a peculiar crystalline form? The lengthy memoir is rather a crystallographical essay.

Researches on the Action of Oxychloride of Carbon upon the Carbides of Hydrogen.—Dr. Berthelot.—In the introduction to this memoir, the author says that, while experimenting with oxychloride of carbon, he found, to his surprise, that this gas does not possess the chemical activity commonly attributed to it of late. This discovery induced him to repeat Harnitzky's experiments on the synthesis of organic acids, by causing the oxychloride of carbon to react upon carbides of hydrogen. The author states that, notwithstanding every exertion made by him, he did not succeed in obtaining any of these substances; and relates, at great length, what reactions, if any at all did take place, between the oxychloride and marsh-gas; acetylen and benzol; oxychloride, with excess of chlorine; nascent oxychloride and an impure oxychloride; and the same hydrocarbides.

History of Oxychloride of Carbon.—Dr. Berthelot.—The most salient part of this paper is that, when oxychloride of potassa is placed in contact with slightly-damped bicarbonate of potassa, the volume of the gas increases three-fold, and is still completely absorbed by caustic potassa—

$$C_2O_2Cl_2+2(C_2O_4.KO.HO)=3C_2O_4+2KCl+H_2O_2.$$

Analysis of Mixtures of Gases Containing Oxychloride of Carbon.—Dr. Berthelot.—Suppose a gas mixture to contain chlorine, oxychloride of carbon, oxide of carbon, oxygen, and nitrogen. Shake the mixture first with some mercury, to remove the chlorine; caustic potassa solution removes oxychloride; pyrogallate of potassa removes oxygen; protochloride of copper removes oxide of carbon. Let the mixture contain—Oxychloride of carbon, hydrochloric acid, carbonic acid, oxide of carbon or carburetted hydrogens, oxygen, and nitrogen. Mercury is applied for the removal of chlorine. One single drop of water dissolves and takes the hydrochloric acid, without affecting either the oxychloride or carbonic acid, one single drop of absolute alcohol first dissolves the oxychloride, converting it into an ether which, along with any vapour of alcohol, is removed by a drop of concentrated sulphuric acid. The residue is treated by a single drop of a concentrated solution of caustic potassa, which takes up carbonic acid; the oxygen is removed by pyrogallate of potassa, the hydrocarbides by bromine, and the oxide of carbon by protochloride of copper.

On Chloride of Acetylen, and on the Synthesis of Julin's Chloride.—Drs. Berthelot and Jungfleisch.

Action of Hydrate of Potassa upon the Sulphuric Acid Derivatives of Hydrocarbons.—Dr. Berthelot.

Synthesis of Acetic Acid from Acetylen.—Dr. Berthelot.—These three papers have appeared in a condensed state in the *Comptes Rendus*, and were noticed by us.

Products of the Condensation of Valeric Aldehyde.—J. Riban.—The author states that his chief object is to say that, while M. Borodine has preceded him in the publishing of results obtained on this subject (see Chemical News, vol. xx., p. 286; *Am. Repr., Feb.* 1870, *p.* 104, quoted by J. Riban), he reserves to himself the right of giving his experiments, as made at a date anterior to M. Borodine's, whose researches he confirms as correct.

Salicilonitrile.—E. Grimaux.—A continuation of a former paper.

On Phenate of Isopropyl and some Bromated Derivatives.—R. D. Silva.—Phenate of isopropyl, $C_6H_5(CH_3-CH-CH_3)O$, is a colourless, somewhat viscous liquid, smelling like essence of geranium; boils at 176°; sp. gr. at 0°, 0·958; refraction index, 1·5124; vapour density, 4·73. Monobromated isopropyl, $C_6H_4Br(CH_3-CH-CH_3)O$, a colourless, rather viscous liquid, insoluble in water, soluble in alcohol and ether, and boiling at 236°; sp. gr. at 0°, 1·981. Perbromated phenate of isopropyl, a solid substance fusing at 95°.

Bromotoluen and Paratoluidine.—O. Wallach.—The main object of this paper is a rectification of errors committed, according to the authors, at least, by M. Rosensteihl, who stated that the author had mistaken a mixture of pseudotoluidine and toluidine for a bromotoluen.

Letter from M. Kraut to the Editor of the "Bulletin," Requesting Correction of some Abstracts from M. Kraut's Paper on Salicylic Compounds.—A brief notice, the greater portion of which is occupied with formulæ—*e. g.*, trisalicylosalicylic acid—

$$H.O.C_6H_4.CO.OC_6H_4CO.O.C_6H_4CO.O.C_6H_4.CO.O.H.$$

Annales du Genie Civil, January, 1870.

This periodical rarely contains original papers on chemistry and allied sciences; but this number contains a paper on—

Soap and Soap Making.—L. Droux.—Divided into several sections. Introduction; from what time, or period, does the making of soap date? soap was known to the ancients; soap making at Marseilles in the 17th century; artificially-made soda, vegetable oils, and oleic acid; distribution of the soap-works over Europe; soft soap unknown and never used in southern countries; legislative enactments, as regards soap and the fiscal duties thereon; statistical review of the importance of the soap manufacture in France, the United Kingdom, and other European countries. This is simply the skeleton of the contents of this, in many respects, very important paper. Soap, the author proves, was known to the ancients at a very remote period, but its manufacture was not generally well understood. It appears we are in Europe indebted to the Saracens for the re-discovery of the manufacture of soap, as much as for the discovery of the manufacture of paper, sugar refining, and other industrial arts.

Zeitschrift für Chemie von Beilstein, No. 3, 1870.

This number contains the following original papers:—

Formation of Ozone During Active Combustion.—O. Loew.—After referring to the well-known instances of the formation of ozone during slow combustion and oxidation, the author gives the opinion that every act of oxidation, whether slow or more rapid, is accompanied by the formation of ozone just previous to the combination between the substance to be oxidised and the oxygen converted into

a state of great activity taking place. The following experiment is described to prove this dictum:—A current of air is blown through a rather wide glass tube towards the flame of a Bunsen gas burner; and opposite the end of the tube, which is directed towards the flame, a suitably-sized beaker-glass is held; and after a few seconds, the blowing is discontinued, and the beaker-glass simultaneously covered with a glass plate. When the air contained in the beaker-glass is tested, it will be found to emit the peculiar odour of ozone, to blue guaiacum paper, and to separate iodine from iodide of potassium. The formation of ozone is greatest when the current of air is so strong as nearly to cause the extinguishing of the flame. The experiment succeeds with every other kind of flame, provided care be taken so to regulate the current of air as to exclude the presence of intermediate products of combustion, as, for instance, vapours of partly-consumed alcohol, if a spirit-flame be used. The author draws from his researches the following conclusions:—(1) Oxygen is first converted into ozone in every case where active combustion takes place. (2) Far more ozone is formed than is required for the keeping up of the process of complete combustion and oxidation of the oxidisable material. This surplus of ozone is, in all ordinary cases of combustion, destroyed, partly by the high temperature, and partly by the rush of cold air, and draught thereby caused, attending the combustion.

Dissociation of Fluid Sulphuric Acid, and on a General Method of Estimation of the Degree of Dissociation of a Fluid Compound.—L. Pfaundler.—The author first briefly refers to W. Dittmar's paper on this subject, and next gives a lengthy tabulated form, exhibiting the results of his researches on the dissociation of sulphuric acid, finishing his paper with a number of algebraical formulæ suitable for the calculation of the degree of dissociation of any fluid compound.

Regressive Formations (Regressiv Bildungen) of the Tri-Substituted Guanidines.—V. Merz and W. Weith.—It is rather to be regretted that the authors of this paper have not commenced it by giving a concise explanation of what they understand by regressive formations, which is not at all clear from the contents. Sulpho-carbanilide is decomposed (so the paper begins), by the action of heat, into triphenyl-guanidine, sulphide of carbon, and sulphuretted hydrogen. From the further contents and description of experiments, it would appear that, by regressive formation, is meant a regeneration of a substance—say, sulpho-carbanilide—while being heated, so that, instead of its entire decomposition as final result, there is found a large quantity (the authors mention even 90 per cent) of the substance unacted upon by heat. The chief illustration given of what is understood by the regressive (better, perhaps, in English, regencrative) process is rendered by the following formulæ, referring to the two reactions by which sulpho-carbanilide can be obtained from triphenyl-guanidine; the formulæ hold good also, regressively:—

$$\begin{array}{lcl} N<^{C_6H_5}_{H} & & N<^{C_6H_5}_{H} \\ | & & | \\ C{=}NC_6H_5+CS_2 & = & C=S \quad +C<^{S}_{NC_6H_5} \\ | & & | \\ N<^{H}_{C_6H_5} & & N<^{H}_{C_6H_5} \\ N<^{C_6H_5}_{H} & & N<^{C_6H_5}_{H} \\ | & & | \\ C{=}NC_6H_5+H_2S & = & C=S \quad +C_6H_5.NH_2 \\ | & & | \\ N<^{H}_{C_6H_5} & & N<^{H}_{C_6H_5} \end{array}$$

Note on Oxalate of Silver.—F. A. Mühlhäuser.—The author says, Drs. Thudichum and Wanklyn stated some time ago, in contradiction to Gmelin, that oxalate of silver is an anhydrous salt; but, however correct the statement of the gentlemen just named may be, it is no novelty at all, having been long since mentioned in the *Annalen der Chemie* (101, 177). The author adds—It would have been of far more value to science if the parties had communicated their mode and means of correctly analysing a salt which is very readily decomposed with explosion.

Products of Condensation from Oenanthol.—Hugo Schiff.—About twenty-one years ago, says the author, Dr. Williamson found that a solution of oenanthol in four volumes of alcohol, saturated with HCl, yielded, on addition of water, oenanthic ether. The author contradicts this, stating at the same time that Dr. Williamson's oenanthol has been, in all probability, largely contaminated with oenanthic acid, since pure oenanthol, previously saturated with HCl and dissolved in alcohol, separates into two layers, distinctly exhibiting a different specific gravity. The chief product of this reaction is septenoxyethyl-chloride—

$$C_7H_{14}\begin{cases} O.C_2H_5 \\ Cl \end{cases}$$

a substance insoluble in water, soluble in alcohol and ether and becoming gradually decomposed, even by the addition of warm water. This substance is dissociated by distillation, yielding hydrochloric acid, ethylen, chloride of ethyl, steam, a mixture of hydrocarbons, and a couple of oxygenated compounds. The following products of fractional distillation were obtained from the residue of the first distillation, carried on to 320°:—Oenanthylen, C_7H_{14}, boiling-point, 90—100°; a fluid boiling between 245° and 260°, $C_{14}H_{26}$; boiling between 320° and 330°, $C_{14}H_{22}$; residue left at 350°, $C_{14}H_{18}$. The remainder of this paper is devoted to a lengthy discussion, accompanied by a large number of formulæ, to explain how the different substances and products of the complex reactions are derived from the original material applied for the preparations.

Sulpho-Fumaric Acid.—B. Credner.—Sulpho-fumaric acid, $COOH.CH_2.CHSO_2OH.COOH$.—The preparation and purification of this substance are described at length; the process is complicated and tedious. The pure material is a syrup-like, very sour fluid, which, by being kept over sulphuric acid, yields traces of crystalline appearance; the acid and its salts, a number of which are described, are isomeric, but not identical with sulpho-succinic acid. Sulpho-fumarate of potassa, $C_4H_3K_3SO_7+H_2O$, is a crystalline mass which effloresces on exposure to air. Neutral sulpho-fumarate of lead—

$$C_4H_3Pb_3'O_7S+2H_2O,$$

is a salt readily soluble in water, in aqueous solution of acetate of lead, and in free acids, and obtained by double decomposition of a potassa salt of the acid in question, can never be obtained quite free from potassa. The basic lead salt of this acid $C_4H_3Pb'_3O_7S+Pb_2O$, is a crystalline compound, rather insoluble in most menstrua.

Behaviour of Salicylic Aldehyde when it is Heated with Primary Monamides.—B. Credner.—This paper treats of the action of acetamide upon salicylic acid at an elevated temperature, resulting in the formation of a substance soluble in alcohol, yielding, on elementary organic analysis, in 100 parts:—C, 57·82, 58·56, 64·35; H, 5·80, 6·18, 5·55; N, 8·01, 7·81. After purification with alcohol, the figures obtained were—C, 65·33, 68·48, 66·29, 63·27; H, 5·81, 6·40, 5·73, 5·69; N, 8·11, 7·35. When salicylic aldehyde was heated with benzamide, a similar substance was obtained.

Comptes Rendus des Séances de l'Académie des Sciences, February 21, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Cause of the Electro-Capillary Currents in the Bones, Nerves, and Brain.—E. Becquerel.—A physiologico-physical treatise.

Synthesis of Aromatic Acids.—A. Wurtz.—The substance mainly described in this paper is dibenzyl-carboxylic acid, $C_{15}H_{14}O_2$, obtained by the action of sodium upon chloride of benzyl and chloroxycarbonic ether, according to the following formula:—

$$2(C_7H_7Cl)+CO\left\{\begin{matrix}Cl\\O.C_2H_5\end{matrix}\right\}+3Na=3NaCl+H+C_{14}H_{13}—CO_2.C_2H_5.$$

This acid is almost insoluble in cold water, somewhat soluble in boiling water, and very readily soluble in alcohol and ether. It is a solid substance; it fuses at 84°; at a very high temperature, it boils, and distils over without alteration. The salts of this acid crystallise with difficulty; the calcium salt yields, when submitted to dry distillation along with excess of lime, a mixture of dibenzyl and stilben.

Stability of the Normal Propylic, Butylic, and Amylic Alcohols, considered as Chemical Species (Especes Chimiques).—J. Pierre and E. Puchot.—The authors have studied chiefly—The temperature of ebullition; the specific gravity at 0°, and at various other temperatures; the index of refraction at one and the same temperature; and the action of polarised light of the substances just named. The results are given in the shape of tabulated forms.

Report on the Labours Concerning Ozone.—Aug. Houzeau.—From this very lengthy paper, we quote an almost unknown fact—viz, that, as far back as the year 1785, Dr. van Marum, at Haarlem, noticed that oxygen was curiously modified after it had been submitted for some time to the passage of electric sparks. He proved that the gas thus acted upon oxidised mercury very rapidly at the ordinary temperature of the air; and he also particularly noticed the peculiar odour the gas had acquired. The author quotes the following new method for the preparation of ozone:—Binoxide of barium is treated for this purpose with sulphuric acid; the oxygen given off is strongly ozonised. It is also observed that the presence of ozone in air, although very probable, has not been hitherto undeniably proved, while the presence in air of various other substances, among these, hyponitric acid, cannot be denied; and a great difficulty arises from the similarity of the reactions with the same reagents exhibited by these bodies. This paper is a complete monograph on ozone.

Researches on the Artificial Digestion of Amylaceous Matter by the Aid of Maltine.—L. Contaret.—Maltine is obtained from barley-malt by steeping that substance in tepid water. The substances thus extracted from malt, and collectively called maltine, or vegetable diastase, has been applied by the author for experimenting upon starchy substances, and converting these, at about 38°, and under the influence of water, into dextrine and sugar (glucose). The author's maltine is very similar to, if nor identical with, the much-vaunted malt extract.

Method Adopted by the late L. Foucault to Recognise whether the surface of a Mirror is Rigorously Parabolic.—A. Martin.

A New Kind of Thermometer.—A. Lamy.—Some time ago. this author proposed a pyrometer based upon the dissociation of carbonate of lime; he now proposes to apply ammoniacal chloride of calcium, which gives off ammonia at low temperatures. The instrument is to be connected with a manometer, which will record the temperature. The contrivance is to be especially adapted to record the temperature at different depths under the surface of the soil. M. E. Becquerel and others very properly observe that better and far more accurate means for accomplishing this purpose exist already, and are daily successfully employed.

Some Observations on the Diamond Found at Blaschkowitz (Bohemia).—A. Schafaritz.—In order to settle all doubt about the true nature of this diamond, the author has burned, in a current of oxygen, and with suitably-arranged apparatus, a sufficient quantity of this stone to prove that it is completely consumed, yielding only carbonic acid. We, moreover, learn from this paper that the geological conditions of the locality where this stone has been found bears a great resemblance to the geological conditions of that portion of the Brazil where diamonds are constantly sought for.

Combination of the Hydracids with Bromated Ethylen and Propylen.—M. Reboul.

Action of the Haloids in Free State, and of some Chlorides, upon Glucose.—A. Colley.—After referring to the action of the haloids upon anhydrous glucose at a high temperature (80° to 112°), and, also, after having mentioned the influence of water and the action of hydrochloric acid upon glucose, the author describes, at great length, the action of chloride of acetyl upon this substance when placed in a sealed tube; the result is the formation of acetochlorhydrose, a solid body capable of crystallising, insoluble in water, and soluble in alcohol, ether, and chloroform. On being submitted to elementary organic analysis, results were obtained leading to the formula $C_6H_7(C_2H_3O)_4O_5Cl$. Its mode of derivation from glucose is represented by—

$$C_6H_{12}O_6+5C_2H_3OCl=C_6H_7(C_2H_3O)_4Cl+C_2H_4O_2+4HCl$$

This formula is exactly reproduced from the original.

A New Phosphated Compound.—L. Darmstädter and A. Henninger.—While causing an ethereal solution of phosphuretted hydrogen to act upon chloride of cyanogen, the authors have obtained—

$$P\left\{\begin{matrix}CN\\C_2H_5\\H\end{matrix}\right.$$

a solid substance, crystallising in rhombic-shaped crystals, fusing at about 50°, and volatilised without decomposition. This cyanethylphosphide is readily soluble in water, alcohol, and ether, and its formation is elucidated by—

$$CNCl+PH_3+(C_2H_5)_2O=CNPH(C_2H_5)+HCl+C_2H_5.OH.$$

Chemical and Therapeutical Researches of the Thermo-Mineral Water of the Solfatara of Pouzzoles (Italy).—S. De Luca.—This mineral spring, met with near Naples, is remarkable for containing arsenic, free sulphuric acid, and a number of other substances, amounting per litre, to—Suphuric acid (calculated in anhydrous state), 1·473 grms.; chlorine, 0·0085; protoxide of iron, 0·1105; lime, 0·101; magnesia, 0·0225; potassa, 0·017; ammonia, 0.0135; alumina, 0·335; silica, 0·315; soda, manganese, arsenic, and nitrogenised organic matter, traces. As regards the presence of arsenic, the author states that the volcanic fumarola, close to the spring, yields vapours among which the presence of sulphide of arsenic is readily made visible, by holding, for a moment, any cool substance, even paper, at the place whence they exude to obtain crystals of sulphide of arsenic. This water yields, on evaporation, excellent alum, and is therapeutically applied, internally as well as externally. The temperature is not mentioned.

February 28, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Modifications Produced by Magnetism in the Light Emitted by Rarefied Gases Enclosed in so-called Geissler Tubes.—Rev. A. Secchi, S.J.

New Studies on Propylic, Butylic, and Amylic Aldehydes.—I. Pierre and E. Puchot.—Pure propylic aldehyde is a limpid, colourless liquid, boiling at 46°; it emits a suffocating odour; is so prone to oxidation, that it is difficult to obtain it free from propionic acid; reduces nitrate of silver readily; sp. gr. at 0°, 0·8327, at 32°, 0·7906. Butylic aldehyde is also a limpid, colourless liquid, which readily reduces salts of silver, and boils at 62°; sp. gr. at 0°, 0·8226, at 27·75°, 0·7919 Amylic aldehyde, also a li-

quid, boils at 92·5°, and is very readily converted, by oxidation, into valerianic acid; sp. gr., at 0°, 0·822, at 4·34°, 0·779.

Determination of the Form of our Globe by Experimental Means.—G. Lambert.

Note on the Physical Condition of Bodies.—F. Lucas.—Both these papers are physico-mathematical essays.

Observations made of a Meteorite at the Observatory at Paris.—MM. Wolff, Adré, and Capitanes.—A concise account of a meteorite seen on the 26th of February last, at 9·35 p.m.

Foucault's Method of Autocollimation, and its Application to the Study of Parabolic Mirrors.—A. Martin.

Divers Orders of Spectra of the Simple Bodies.—Dr. Dubrunfaut.

Solution of Reducing Gases by Molten Iron and Carburets of Iron when in Liquid State by Fusion.—H. Carom.—The author of this paper states that the spirting of fused cast-iron is not due, as has been stated by M. H. St. Claire-Deville, to the solution (or absorption) of certain gases in these metals while at a high temperature, but is the result of a peculiar reaction which continues until the metal is completely solidified. M. H. St. Claire-Devi le replies that, whether the gas be oxide of carbon or hydrogen mixed, or whether it be oxide of carbon only, it is the gas which causes the spirting, and often even the projection, of large quantities of molten metal to great distances.

Oxidation of Iron.—F. C. Calvert.—This paper contains a full description of a series of experiments made with the view to establish precisely the causes of and conditions under which iron rusts. The author comes to the conclusion that the carbonic acid, as well as the watery vapour, contained in the atmosphere concur jointly in causing iron to rust. Prof. Chevreul makes the following observations on this subject:—Claude Bourdelin was the first who observed (in 1683) that ammonia is formed when aërated water acts upon steel. In 1720, E. F. Geoffroy found that iron rust formed in the air contains moisture and ammonia. Vanquelin found ammonia in the specks of rust formed upon a chopper, of which it was suspected that it had been used for murdering somebody; the presence of ammonia in iron rust should, therefore, be cautiously dealt with in medico-legal questions. According to Dr. Calvert, pure iron does not decompose pure water at the ordinary temperature; and if this is correct, the fact observed by Prof. Chevreul, that the white hydrated protoxide of iron decomposes water, becomes more interesting.

Dissociation of Ammoniacal Compounds.—F. Isambert.—The author describes a series of experiments made with anhydrous double salts of ammonia, zinc, and cadmium sulphates, and the dissociation of these by heat (100°), aided by vacuum. The general conclusion arrived at by the author is that, by the action of ammonia gas upon the chlorides or sulphates of the metals alluded to, there is, independently of the chemically-combined ammonia, some of that gas absorbed in the same manner as charcoal is capable of doing. The compound $CdOSO_3,3NH_3$ is to be considered as made up of $(CdOSO_3,NH_3)2NH_3$.

Aurora Borealis and other Meteorological Phenomena Seen and Observed in Piedmont on January 3rd, 1870.—Rev. P. Denza, S. J.

Cosmos, February 26, 1870.

The Newton-Pascal Forgeries.—The forger of these and other documents (a number of 27,000, only taking into account those purchased by M. Chasles, who paid £5,600 for the same) is now on his trial before one of the tribunals of Paris.

Discovery of Coal in the Brazil.—R. von Brause states that he has discovered coal of very good quality in the Province of Santa Catharina, near Araranguá. The seam which crops out has been explored for a distance of some 30 miles, and found to be of an average thickness of 1 metre. This coal has been thoroughly tested and analysed by Dr. Netto, of Rio de Janeiro, and is interesting as one of the very few instances of a true coal occurring in a recent geological formation, although in the United States and in Hanover (on the very borders of the Netherlands), two or three such occurrences are on record. The coal here alluded to is an excellent quality of gas coal.

Curious Instance of Spontaneous Combustion of the Human Body.—Dr. Bertholle.—This paper relates a duly authenticated case of this rare phenomenon. The victim, a woman aged 37 years, was a confirmed drunkard. Many of our readers will recollect, perhaps, that Prof. Liebig wrote a paper on this subject some years ago, when the medico-legal question arose concerning the death of a noble lady in Germany.

Phosphide of Calcium Applied to Life-Buoys.—F. Silvas.—Experiments have been made at Toulon to try to attach to life-buoys another floating body provided with phosphide of calcium, which, on becoming wet, gives off spontaneously combustible phosphuretted hydrogen, thus emitting light to guide the man who might have fallen overboard and be in search of the life-buoy.

Revue Hebdomadaire de Chimie, February 17, 1870.

Modifications in the Mercurial Air-Pump.—Messrs. Alvergniat Frères.—The improvement here alluded to cannot be well understood without reproduction of the cut; but there is no doubt that this modification will soon be generally adopted, since it greatly aids the efficiency of this apparatus.

Quality of the Kerosene Oil as Met with and Sold at New York.—C. F. Chandler.—The first portion of a report to the Imperial City's Board of Health on this subject.

Carbonisation of Dry (Non-Caking) Coal.—E. Péricot and T. Appolt.—This paper is a first instalment on the means by which coke of good quality may be made from *houille maigre*—that is to say non-caking coal. This property may be due to either excess of carbon (as in anthracite), excess of oxygen (as, for instance, in the coal from Saarbrück, which contains 17 per cent of that element), or to excess of ash (as, for instance, the Boghead and some other Cannel coals); but, as regards the latter, there are other causes in play for preventing them from caking, and, among these, the water they contain in a peculiar manner.

February 24, 1870.

This number contains the continuation of the following original papers:—

Quality of the Kerosene Oil as Sold at New York.—Prof. C. F. Chandler.—The specific gravity of the native petroleums varies from 0·773 to 0·910; and the average composition of crude Pennsylvania petroleum is, in 100 parts—Gazoline (sp. gr., 0·744), 10 parts; naphtha (sp. gr., 0·752), 10 parts; oils fit for burning and lubrication, 76 parts, varying in sp. gr. from 0·844 to 0·760. The paper further contains a large amount of information concerning the American regulations for the sale and testing of petroleum, and gives a tabulated review of the composition of some specimens of kerosene sold at New York, from which it appears that some kinds contain no less than 90 per cent of the very volatile oils, while in other instances, again, the quantity of the latter is *nil*.

Carbonisation (Coke Manufacture) of Non-Caking Coal.—The main point here brought forward is the well-known washing process, whereby the earthy constituents of the coal are removed, and, having become decreased in quantity, admit of the agglomeration of the organic matter when heat is applied. The admixture of a

good quality of caking coal is advocated for obtaining coke from anthracite.

Holtz's Electrical Machine.—M. L. Mène.—This complete description of this machine, as improved by M. Bouchotte, is accompanied by a couple of woodcuts.

Annales de Chimie et de Physique, January, 1870.

This number contains only two original memoirs:—

Estimation of Carbon in Cast-Iron, Wrought-Iron, and Steel.—M. Boussingault.—The paper, a lengthy essay on this subject, opens with the quotation of the results of an analysis of white cast-iron smelted with charcoal at Medellin, in New Grenada. In 100 parts, this substance contained:—Combined graphite, 4·40; silicium, 0·75; phosphorus, 0·07; sulphur, traces; nitrogen, 0·0118; manganese, 0·84; chromium, 1·95; vanadium, traces; iron, 92·50. The paper contains the following sections, headed—Attacking iron by the dry process—*i.e.*, with bichloride of mercury; attacking iron by the wet process; estimation of carbon in cast iron, wrought iron, and steel.

Temperature of Flames, and on Dissociation.—E. Vicaire.—This is the first instalment of a lengthy memoir on this subject, accompanied by several engravings.

February, 1870.

This number contains continuation and end of last-named memoir, and—

Migration of Nitrogen during the Process of Beet-Root Sugar Manufacture.—A. Renard.

Optical and Crystallographical Researches on the Clino-Rhombic Form of Tungsten.—M. des Cloizeaux.

Simultaneous Estimation of Carbon, Hydrogen, and Nitrogen in the Elementary Analysis of Organic Substances.—Th. Schlœsing.—This excellent memoir cannot be well understood without the reproduction of the several woodcuts annexed to it.

On the Effect Motion has upon the Vibrations of Sound, and on the Length of the Wave of the Rays of Light.—H. Fizeau.

Regulator for the Use of Gas in Chemical Laboratories.—Th. Schlœsing.—Cannot be usefully abstracted without the reproduction of the woodcuts.

Researches on Camphor and some of its Derivatives.—H. Baubigny.—This is the first portion of a lengthy monograph on this subject, divided into the following sections:—Introduction, treating briefly on the researches made on camphor by various authors; action of sodium upon camphor; action of water upon sodium products, and formation of borneol; action of the bromides and iodides of the radicals of the diatomic alcohols upon the sodium derivatives from camphor.

Moniteur Scientifique, No. 317, March 1, 1870.

Contains the following original papers:—

Oil Refining.—M. de Keyer.—This process is equally applicable to all fat or fixed oils. Take, for 100 kilos. of oil 600 grms. of liquid ammonia, diluted with the same quantity of water; the mixture is vigorously stirred for about half-an-hour, and next left quietly standing for three days, care being taken to keep the vessel containing the mixture well closed. The oil having been decanted from the sediment (which is applied for soap-making), is ready for use after washing with water and filtration.

Researches on Molasses, and on the Divers Processes of Sugar Refining as Applied in Paris.—Dr. Dubrunfaut.—A lengthy monograph, of interest chiefly to sugar refiners.

Direct Application of Suint to the Manufacture of Cyanides.—Léon Sauvage.—In reference to what was stated in this periodical (see abstract, vol. xxi., p. 71), this author writes to say that he obtained, on the 30th of December, 1864, a *brevet d'invention* for this invention, and that this *brevet* is now public property. The author's object is to state that his is the right of priority.

Journal für Praktische Chemie, No. 18, 1869.

This number contains the following original papers and memoirs:—

Preparation of Pure Titanic Acid and its Separation from Zirconium and Iron.—G. Streit and B. Franz.—The first section of this paper is devoted to a comparative review of the methods hitherto in use for the disintegration and solution of minerals containing the substances named above. The preparation of titanic acid by the method suggested by the authors, consists in fusing rutile, first, with three times its weight of carbonate of potassa at a high temperature in fire-clay crucibles. The fused mass is poured out on a piece of sheet-iron, so as to form, on cooling, a thin cake; this is next ground to powder, and exhausted with water, and, after removal of the silica, treated with crude hydrochloric acid, no heat being at first applied. The several operations of filtration and washing by decantation having been got through, the titanic acid is precipitated by means of a mixture of acetic acid and dilute sulphuric acid, and boiling, by the aid of steam, for some ten hours. The separation of zirconia from titanic acid is discussed at great length; the authors experimented with a solution containing 4·23 grms. of TiO_2, 0·188 of FeO, and 0·062 of Fe_2O_3, and added thereto the sulphuric acid solution of 0·613 grm. of zirconia. To the solution was then added its own bulk of acetic acid, and the liquid boiled; all the titanic acid was hereby precipitated, while iron and zirconia remained in solution. From the filtrate the two latter substances were precipitated by ammonia, and, after having been collected upon a filter, washed, dried, ignited, and weighed, the iron was estimated in the re-dissolved substance volumetrically.

Formation of Sulphuretted Hydrogen from Water and Sulphur.—J. Meyers.—While experimenting on the boiling-point of sulphur, the author detected the presence of sulphuretted hydrogen; and this induced him to make, purposely, an experiment whereby steam was made to pass over sulphur kept boiling in a tube. A large quantity of sulphuretted hydrogen was formed, and, simultaneously, pentathionic acid. The following formula explains the process:—

$$15S+10H_2O=10H_2S+5SO_2=H_2S_5O_6+5H_2S+5S+4H_2O.$$

This number contains the notice that Dr. H. Kolbe has been appointed chief editor of this journal, which will in future appear in fortnightly numbers, excepting that during the months of August and September no issue takes place; but, exceptionally, the journal will be published during these months in the current year, to make up for backward appearance during the first two months of 1870.

Revue des Cours Scientifiques de la France et de l'Etranger, February 26, 1870.

This number does not contain any papers relating to chemistry or sciences allied therewith.

Comptes Rendus des Séances de l'Académie des Sciences, March 7, 1870.

This number contains the following papers and memoirs relating to chemistry and physical sciences:—

Electromotive Force of Divers Substances, as, for instance, Pure Carbon, Gold, Platinum, &c., in the Presence of Water and other Fluids.—E. Becquerel.—This paper contains the description of a series of

very accurate experiments made with chemically pure substances. Among the curious facts elicited is this, that pure gold, obtained from the French Mint, is acted upon by pure water in a manner not hitherto explained, but which gives the author occasion to ask whether, possibly, gold does not contain another substance, which has not been discovered, or whether, perhaps, the slow action of the water is not the cause of the disaggregation of the gold, and thus explains the fact of its being found in rivers in the state of dust.

Elucidating Remarks on M. Charles.—J. Dupuis.—In the meeting of the 7th of February last, mention was made of some papers, manuscripts, and books presented to the Academy, formerly the property of the celebrated physicist, Charles. It appears that some confusion has arisen, since there have been two scientific men bearing this surname—viz., Jacques, born at Cluny, a celebrated mathematician, who died on the 22nd of August, 1791; and Jacques Alexandre César, born at Baugency, on the 12th of November, 1746, who died in 1823, and it is this latter celebrated physicist whose papers, memoirs, &c., have been accepted by the Academy for its library.

Observations of the Colours Exhibited by Rarefied Gases when Submitted to Spectrum Analysis.—J. Dubrunfaut.

Electromotive Force which Platinum Evolves when brought into Contact with Divers Liquids.—J. M. Gaugain.

Formation of Icicles.—Lecoq de Boisbaudran.—A paper illustrated with several woodcuts, absolutely necessary for it to be properly understood.

Illumination of Transparent Bodies.—M. Soret.

Absence of Oxygenated Water in the Snow Fallen at Rouen.—A. Houzeau.—This paper contains an account of very carefully executed experiments to detect the presence of peroxide of hydrogen (*eau oxygénée*) in water obtained from snow, care being taken to prevent the loss or decomposition of the peroxide alluded to. The author's opinion is that, since the experiments made at Kasan undoubtedly proved the presence of the peroxide of hydrogen in snow water, there may exist an essential difference, caused by the locality where it falls. Kasan is situated almost in the centre of the Russian empire, far away from any seas or oceans.

Poisoning with Hydrocyanic Acid and Cyanides.—M. Bonjean.—This paper contains a very interesting account of a series of experiments made with living animals, in order to establish positively whether, after their death, such substances as hydrocyanic acid and cyanides can be detected with perfect certainty by chemical analysis. The contents of the paper are too lengthy for full and useful abstraction, but deserve attention, especially for medico-legal questions.

Rain of Sand which occurred in Italy on the 13th and 14th of February last.—Rev. P. Denza, S.J.—This lengthy memoir contains the account of a very curious phenomenon—viz., rain, in the southern parts of Italy, accompanied by a fall of a fine reddish sand, while, in the northern parts of that kingdom, snow fell accompanied by the same substance. The sand has been tested, and found identical with that which is now and then carried by gales of wind from the African desert, not simply into Italy, but even sometimes into Switzerland, where some of it fell, along with snow, at Tscappina (Canton des Grisons). This paper contains many curious facts relating to a phenomenon which is sometimes observed also on the Canary Islands.

Action of Ozone upon Nitroglycerine, Dynamite, and other Explosive Substances.—J. Jouglet.—According to the author's experiments, nitroglycerine, dynamite, iodide of nitrogen, chloride of nitrogen, and some other similar compounds explode the very moment they are brought into contact with ozone; so that, for instance, a drop of nitroglycerine, introduced into a vessel containing ozone, causes an instantaneous explosion. Picrate of potassa gunpowder and ordinary gunpowder are slowly decomposed by ozone, a decomposition which, as regards the last-named substance, takes several weeks before it is perceptible.

Les Mondes, February 24, 1870.

Solar Temperature, and the Means by which it is Kept up.—Rev. A. Secchi, S.J.—The *résumé* of this memoir, originally published in the Italian language, is given in the following few lines:—The sun is a globe possessed of an enormously-high temperature, undoubtedly reaching many millions of degrees; but our means of estimating that temperature are very imperfect. As to the origin of this high degree of heat, it may have been the result of the force of gravitation which has united the elements of which the central point of the system (viz., of our solar) has been made up; the initial temperature, therefore, the result of mechanical action, will, of necessity, have been far greater than the present temperature of the sun is, which is certainly cooling down. However great this loss of heat may be, it is imperceptible to us, since it is slowly taking place, and partly compensated by chemical actions which take place in the sun, which is, in all probability, in its interior, a mass of strongly-compressed and condensed nebulous matter.

Handbook of General Cosmography.—H. J. Klein.—This is highly eulogised as a compendium explaining, in a clear and precise style, everything at present known of our solar system and its constitution. The author has followed, as pattern, the celebrated von Humboldt's *Cosmos*.

Cleansing of Raw Sugars, and Extraction of Sugar from Molasses, by means of the Saccharate of Hydrocarbonate of Lime.—J. Boivin and T. Loiseau.—Under the name of *sucrate d'hydrocarbonate de chaux* (saccharate of hydrocarbonate of lime), the authors describe, but do not exactly define, a peculiar compound of lime-water and sugar, to which some peculiar properties are ascribed. The main gist of the paper is a lengthy account of an enumeration of the processes in use for refining sugar at the refinery of MM. Sommier and Co., La Villette, Paris, according to the system of the authors, but any one acquainted with sugar refining will at once perceive that the paper is vaguely worded, and that there is a want of precision in it.

Apparatus for Heating the Feed-Water for Steam Boilers.—H. N. Wateso.—This contrivance, which could not be well understood without the reproduction of the cut, is an ingenious arrangement, well deserving the attention of those who wish to save fuel. Emile Leroux, C. E., 43, Rue de Verneuil, Paris, gives full particulars on this subject.

Tungsten Blue.—Tessié du Motay.—Dissolve in a sufficient quantity of water, and successively, 10 parts of tungstate of soda, 8 of tin-salt (protochloride of tin), 5 of ferrocyanide of potassium, and 1 of perchloride of iron. When all these substances are dissolved, the mixture is thoroughly stirred up, and the sediment which is formed is separated by filtration. As soon as the liquid has run off, the moist pasty matter is spread out in thin layers upon suitable glass plates, or shallow dishes, and for several days exposed to the action of strong daylight and sunshine. This slowly causes the formation of a beautifully-blue pigment; and this action may be accelerated by washing the material, so as to remove the matters soluble in water which it yet contains. The blue material has a great similarity with Prussian blue, but differs from it by not being bleached by sunlight; akin to Prussian blue, it resists the action of acids, but not of alkalies. The tungsten blue can be heated to about 180° without decomposition. Its per centage composition, in 100 parts, is—Water, 7·85; tin, 31·69; iron, 5·13; cyanogen, 19·41; blue oxide of tungsten, 35·60; total, 99·68. This blue is not affected by artificial light at all, and is sold at the same price as the very best quality of Prussian blue.

Oxyhydrogen Light.—Tessié du Motay.—A lengthy paper, setting forth chiefly matters of domestic economy, as regards the cost of this mode of illumination, and also detailing improvements made whereby the use of lime or zirconia cylinders is replaced by a suitable system of carburation of the hydrogen gas.

March 3, 1870.

Prize Questions Proposed by the Royal Belgian Academy of Sciences, at Brussels.—(We do not quote those belonging either to pure mathematics or natural history. The study of electrical induction currents, based, as much as possible, upon a new series of experiments to be made. A new series of researches to be made, with the view of establishing the chemical composition and the mutual relation existing between the albuminoid substances. A gold medal (value £40) will be given for a successful answer to the last-mentioned question, while the value of the gold medal to be given for the reply to the other question will be £24. Answers, written in Latin, French, or Flemish languages, to be sent, post-paid, to M. Guételet, the perpetual secretary, on or before June 1, 1871.

Prize Questions Proposed by the Bataafsch Genootschap (Batavian Philosophical Society) at Rotterdam.—We only quote such as belong to chemistry or allied sciences. Determination of the temperature of the water of the oceans at great depth, and in such localities (latitude and longitude) where these determinations have not yet been made; crystallographical examination of such organic compounds as are sufficiently developed to recognise the cleavage of the crystals; determine whether any parts of the sun's surface are possessed of a higher temperature than other portions thereof, and also whether the hotter portions are always the same; the experimental determination of the temperature of decomposition of several chemical compounds, and the estimation of the influence exercised thereupon by the presence of different other substances, and other conditions which may modify that temperature; with at least three liquids, the influence has to be determined which is exercised upon electrolysis when the electrolyte is submitted to pressure: verify, at the same time, whether the facts observed confirm the principle of the conservation of force. By a sufficient number of well-authenticated facts, the question should be settled whether steam boiler explosions are due to a formation of hydrogen gas (decomposition of water), or to the sudden conversion into steam of water previously converted into the spheroidal state; the estimation of the resistance to a galvanic current by liquid mixtures (amalgams in liquid state) of mercury and zinc, and mercury and gold, care being taken that the precise proportions of the metals mixed together, the sp. gr. of each mixture, and the thermo-electric properties such amalgams might possess, be simultaneously indicated; historico-critical account of the observations hitherto made of the electric currents produced in telegraphic wires by thunderstorms and Aurora Borealis. Answer to the question whether any other molecular variations than those produced by the increase of the temperature of bodies affect the rays of the spectrum peculiar to such bodies. Decisive experiments to be taken in order to settle the question between Dr. Tyndall and Prof. Magnus, concerning the greatest absorption of heat by air charged with aqueous vapours. Test, by a series of entirely new experiments, the truth of Dr. Gaugain's statement that conducted electricity is propagated through matter, while free electricity is propagated through the ether. What is the cause of the volcanoes of the Indian Archipelago? The precise estimation of the degree of solubility of gases in liquids, to be determined for at least four gases and eight fluids; the rules generally given for the placing of lightning conductors on buildings should be tested, if possible, by experiments and observations, and therefrom fixed rules established; the more extended study should be made of the conductibility of those electrical conductors termed, by Dr. Gaugain, imperfect conductors; theory, by confirmation, of Holtz's electrical machine; explanation of the phenomena of the spontaneously-becoming charged with electricity of electric conductors placed underground, or underwater, and the means to prevent, or, at least, to neutralize, the effects thereof. For the best answers, a gold medal, value £15, or the money-value, with an additional premium of from £5 to £12; a silver medal for the next best answer. Answers written in Dutch, French, English, German, or Latin languages, accompanied by a sealed billet, bearing outside a motto, and inside the author's name, to be sent, post-paid, to Dr. F. van der Pant, at Rotterdam, on or before the 1st of February, 1870.

Measurement of Forces.—M. Coste.

Movement of the Sea.—J. Quenant.—This author writes from Montmartin-sur-Mer, and, among other things, states that, according to authentic documents, the islands of Jersey and Guernsey have sunk down, during the lapse of the last 500 years, at least 13 metres.

Capital Punishment by means of the Guillotine.—Dr. E. Decaisne.—We simply quote the title of this paper, very opportunely published, since it contains full explanation and sound refutation of the nonsense which has appeared in print of late concerning the retention of vitality, and even consciousness, after decapitation by this machine, introduced in France in 1791.

March 10, 1870.

Candle-Bearing Tree.—This curious tree is only met with near the river Chagres, in the Isthmus of Panama, and was discovered there by Dr. Siemann. It is the fruit of this tree which so perfectly resembles, in shape and colour, that of unbleached wax candles, which has given rise to its popular name, *palo de velas* (candle tree); the botanical name is *Parmentiera cerifera*, and its fruit is eaten by sheep. The fruit known as quamxilotte, and eaten by the Mexicans as a delicacy, is produced by the *Parmentiera pendulus*.

Secreting Organ of, and the Secretion of Sulphuric Acid by, Gasteropode Molluscs.—Paolo Panceri.—Very little is as yet known about the chemical nature of the various fluids produced in and secreted by the non-vertebrated animals. The lengthy paper here quoted describes a very curious phenomenon of the mollusc known as *Dolium galea*, which sometimes grows to a very large size. The saliva of this animal is a colourless, somewhat opalescent liquid, of from 1·025 to 1·030 sp. gr., containing, in 100 parts—Free sulphuric acid, 3·42; combined sulphuric acid, 0·2; combined hydrochloric acid, 0·58; potassa, soda, magnesia, oxide of iron, phosphates, and organic matter, 1·8; water, 94·0. This paper contains, moreover, an anatomical and physiological account of the secretory organs of this animal.

Improved Coffee-Roasting Machine.—M. Marchand.—There is a woodcut annexed to the description of this contrivance, which has been very favourably reported upon by a committee of the chemical Department of the Société d'Encouragement de l'Industrie Nationale.

Revue des Cours Scientifiques de la France et de l'Etranger, March 5, 1870.

From this number, which does not contain any papers relating to chemistry or allied sciences, we learn that M. Delaunay has been appointed Director of the Imperial Observatory at Paris, in lieu of M. Le Verrier.

The Elsasz during the Tertiary Period.—J. Delbos.—An interesting geological paper.

Cosmos, March 5, 1870.

Heating of Steam Boilers.—A. Scheurer-Kestner and E. Meunier.—The authors have made, on the large scale, a series of experiments which prove that only about 60 per

cent of the heat given off by the combustion of coals is really utilised, and the loss is due to the radiation of the exterior surfaces of the boilers. The authors are of opinion that improvements should be directed towards the prevention of this loss of heat; they, moreover, find that the cleaning of the inside of the boilers has great influence, and suggest that this operation of cleaning should be done at short intervals of time.

Preservation of Milk.—Add to every litre (1¾ pints, and 5 oz.) of unskimmed milk, previously poured in a well-annealed glass bottle, 40 centigrs. (about 6 grs.) of bicarbonate of soda. Place the bottle containing the milk, and well corked, for about four hours in a water-bath heated up to 90° (194° F.). On being taken out, the bottle is varnished over with tar: and in that state the milk it contains will keep sound and sweet for several weeks.

Large Fir Tree.—There has been just cut down, at Arwa, in Hungary, a fir tree, 139 ft. high, and 71 inches in diameter at 2 ft. from the soil. This tree, as regards size, is a specimen now very rarely met with in Europe, though more common to America.

Solid Bisulphide of Carbon.—Dr. Von Wartha.—This has been obtained by the rapid evaporation of this liquid itself in the same way as solid carbonic acid is formed. The solid sulphide melts at 9° F. and has the appearance of small cauliflowers.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 145.

This number, and the following (No. 146), do not contain any original papers relating to chemistry or allied sciences.

Monatsberichte der Königlich Preussischen Akademie der Wissenschaften zu Berlin, November, 1869.

The only paper relating to chemistry in this number is a lengthy memoir:—

Contribution to the History of the Sulphuretted Urea.—Prof. A. W. Hofmann.—This memoir contains the following subsections: — Desulphuration of the ethyl-sulpho ureas; desulphuration of the diethyl-sulpho ureas; desulphuration of diethyl urea in the presence of ethylamine; desulphuration of diethyl-sulpho urea in the presence of ammonia; desulphuration of monoethyl-sulpho urea; desulphuration of normal sulpho urea.

Annales du Génie Civil, February, 1870.

This number contains a paper on the—

Utilisation of the Heather. — E. Dromard. — In France, and in a great many other European countries, very large tracts of land are uncultivated and left waste, producing nothing but heather and similar plants. The author's lengthy memoir describes practical methods whereby these plants are employed for the production of charcoal, acetic acid, tar, and other useful products, and the soil so cleared as to become fit for the cultivation of various kinds of fir trees. The contents of this paper are of great interest to agriculturists and landowners.

Pharmaceutische Zeitschrift für Russland, December, 1869.

The only original paper contained in this number is the end of the extremely lengthy memoir—

Monograph on Inuline.—Dr. Dragendorff.

Journal fur Gasbeleuchtung, January, 1870.

Although not directly bearing upon the matters generally treated in our journal, we call attention to an excellent paper, illustrated with a series of beautifully-executed engravings, on the—

Application of Gas Illumination to Theatres.—L. Diehl.—Considering that these buildings so frequently become the prey of flames, occasioning serious loss of life by their conflagrations, this paper is of great interest to all concerned in such matters.

Jahrbuch der Kaiserlich-Königlichen Geologischen Reichsanstalt, No. 4, 1869.

This number contains—

Contribution to the Mineralogical Topography of Austria and Hungary.—F. von Vivenot.—This useful and concise catalogue is alphabetically arranged, as far as the minerals are concerned, while the names of the localities are printed in italics.

Polytechnisches Journal von Dingler, second number for January, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

Possible Causes of Steam-Boiler Explosions.—Dr. H. Schröder.

Bessemer Steel and Heaton Steel Processes.—T. Schinz.

Colorimetric Carbon-Test of Eggertz.—Dr. Dingler.—The result of the author's researches on this subject is, that Eggertz's process is only applicable when the same quantities and qualities of raw materials are continuously applied for the production of cast-iron; but the test fails to give good results with iron and steel of different origin, since it has been found that the presence of other substances —viz., sulphur, copper, phosphorus, and silicium—affect the accuracy of the test.

Chemical Constitution of the Colouring Matter of the Alder Tree.—F. Dreykorn and E. Reichardt.—It is a well-known fact that the wood of the *Alnus glutinosa, L.*, when recently cut, exhibits a series of colourations, rapidly changing from yellow to reddish brown. The authors isolated this colouring matter, which is perfectly insoluble in ether, benzol, and sulphide of carbon, difficultly soluble in absolute alcohol and boiling water, but readily soluble in dilute alcohol in every proportion. The different tests applied to this substance resulted in defining it as a peculiar tannin material; with gelatine solution, it is precipitated, with chloride of iron it yields a green precipitate, and its combinations with the heavy metals are insoluble in water; its formula is $C_{54}H_{28}O_{22}$. This material yields, when split up by the action of sulphuric acid, sugar, and a peculiar reddish brown-coloured resinous substance, insoluble in water and ether, difficultly soluble in alcohol, readily soluble in caustic soda solution and in ammonia, from which solutions it is precipitated again by acids. The splitting-up of the substances is represented by—

$$3(2HO,C_{54}H_{26}O_{20}) + HO = 3(2HO,C_{46}H_{17}O_{11}) + 2(C_{12}H_{14}O_{14}).$$

The memoir describes further, at length, the action of alkalies upon this alder tannin, and the products of the dry, or destructive distillation. The result of these researches is that, by the action of alkalies, there are formed protechuic acid, phloroglucine, and acetic acid. The dry distillation yields pyrocatechine.

Manufacture of Fatty Acids from the Washing of Wool and the Soap-suds Thereof.—Dr. Dingler.—After referring briefly to the researches of Honzeau Muiron on this subject, the author discusses, at great length, this topic; and the chief result is that a material is obtainable, by suitable treatment of the wash-waters of wool, which contains, after the bulk of the water has been removed by

pressure, in 100 parts—Water, 10·66; fatty matters, 34·74; sundry organic matters, 22·37; fine sand, 30·32; soluble silica, 0·08; sulphuric acid, 0·28; phosphoric acid, 0·09; oxide of iron and alumina, 0·99; lime, 0·25; magnesia, 0·10; alkalies, 0·12. This material has been applied for the manufacture of gas, 100 lbs. of it yielding 469·25 cubic feet free from sulphur compounds and of far greater illuminating power than good coal gas. The fatty matters can be extracted, if desired by means of sulphide of carbon.

Journal de Pharmacie et de Chimie, February, 1870.

This number contains the following original papers:—

Sulpho-Carbonic Extracts, and their Application in the Preparation of Medicinal Oils.—J. Lefort.—This is strictly a pharmaco-technical essay, treating, under several separate divisions, on the preparation and properties of extracts (from various medicinal plants) by the employment of sulphide of carbon (refined, of course), and the further application of the extracts thus obtained, to the preparation of medicinal oils.

Adulteration of Cochineal.—E. Baudrimont.—The author states that the more common kinds of this dye material are first softened and swollen, by means of steam, and next rolled about in artificial sulphate of baryta, whereby the substance assumes the appearance of a superior article. The fraud can, however, be readily detected, since, in the first place, the genuine article contains only from 4 to 6 per cent. of water, and this mode of adulteration increases that quantity to 11 per cent.; secondly, the quantity, as well as the quality of the ash, is entirely changed. The author found from 19·5 to 20 per cent of sulphate of baryta in the ash, which, when no adulteration has been attempted, contains no trace of this salt.

Poisoning with the Berries of the Honeysuckle.—Dr. Duval.—That this plant is rather dangerous, on account of its poisonous properties, is well known, but the climate it is cultivated in has some modifying influence. The case here related did not end fatally.

Indian and China Isinglass.—J. L. Souberain.—The author states that the different varieties of this article, as met with in the trade, may be recognised as follows:—Russian isinglass dissolves rapidly and instantaneously in hot water, leaving hardly ever more than at most 2 per cent insoluble residue; Bengal isinglass dissolves readily, but leaves from 7 to 13 per cent of residue. The taste of Russian isinglass is pleasant and sweet; it yields a very firm gelatine, which is perfectly transparent. The Bengal, or Indian kind, often has a fishy taste, and the gelatine it yields is not clear. The Brazilian isinglass yields an opaque, milky-looking gelatine, and its taste is acrid. China isinglass is a rare article in the European markets.

Journal für Praktische Chemie, No. 19, 1869.

This number, which, it should be observed, was published only by the end of last January, in consequence of an interruption having taken place by the death of the editors, as well as the publisher, of this periodical, contains the following original papers and memoirs:—

On the Iodated Salicylic Acids, Oxysalicylic Acid, and Hypogallic Acid.—Dr. P. Liechti.—In the introduction to this memoir, the author refers to the researches of others on this subject, and states that, as regards the solubility of salicylic acid in water, one part thereof requires, at 10°, 2500, at 18°, 1818, and at boiling temperature, from 15 to 20 parts of that fluid for solution. Monoiodsalicylic acid—

$$C_7H_5IO_3 = C_6H_3I \begin{cases} CO.OH \\ OH \end{cases}$$

a crystalline substance, anhydrous, and fusing at 184°, but when covered with water at 98°. One part of this acid requires, at 20°, 893, and at 100°, 104 parts of water for solution. The solutions of this acid and of its salts yield, with chloride of iron, a brilliant violet colouration. The acid contains 48·2 per cent of iodine. Several of the salts of this acid are described at length. Di-iodsalicylic acid—

$$C_7H_4I_2O_3 = C\,H_2I_2 \begin{cases} CO.OH \\ OH \end{cases}$$

a semi-crystalline mass, anhydrous, soluble in 1428 parts of water at 15°, and 656 parts at 100°; readily soluble in alcohol and ether; and becomes decomposed when heated to about 197°. The reaction with chloride of iron is the same in this instance as just alluded to. It contains 65·2 per cent of iodine. Among the salts of this acid, the baryta salts are the most interesting. Oxysalicylic acid—

$$C_7H_6O_4 = C_6H_3 \begin{cases} CO.OH \\ 2OH \end{cases}$$

The author says that, notwithstanding there exists a great similarity between this acid and hypogallic acid, he does not think that these substances are identical. Oxysalicylic acid requires 58·7 parts of water at 21° for its solution, but is readily soluble in boiling water; fusion point, 183°. Even in the cold, this acid reduces an ammoniacal silver solution. The preparation of the oxysalicylic ether is described at great length. In pure state, this substance is a solid crystalline material, fusing at 78°, readily soluble in alcohol and ether, and difficultly so in water. This solution reduces neutral nitrate of silver to the metallic state, even in the cold, and yields, with acetate of lead, a precipitate soluble in acetic acid. Bichloride of mercury is not at all affected by contact with this substance, which also yields with chloride of iron a beautifully deep blue-coloured solution. Opinic and isopinic acids are next described, and the author's researches, compared with those of Drs. Matthiessen and Foster on this same subject. According to Dr. Liechti, opinic and isopinic acids are peculiar modifications of hypogallic acid.

Action of Permanganate of Potassa upon Quinine.—Dr. G. Kerner.—One part of pure quinine is dissolved in excess of nitric or hydrochloric acid in such a manner that a bulk of 100 c.c. contains about 1 grm. of the alkaloid; this solution is heated to between 50° and 60°, and there is then added to it a concentrated solution of two parts of crystallised permanganate of potassa in water, care being taken to keep the fluid well stirred. After removal of the peroxide of manganese, the liquid (which should have an alkaline reaction) is evaporated to about one-eighth of its previous bulk, and next acidified, whereby the newly-formed product of oxidation is precipitated. After having been purified, by frequent re-crystallisation from water, aided, for the removal of some colouring matter, by animal charcoal, a hard crystalline substance is obtained, difficultly soluble in cold water and alcohol, but more readily so in these liquids at their boiling temperature. In many respects, excepting taste and alkaline reaction, this substance exhibits properties very similar in character to those of quinine. The formula of this body, which is dihydroxyl-quinine, is $C_{20}H_{26}N_2O_4+4H_2O$, and its formation from quinine is represented by $C_{20}H_{24}N_2O_2+H_2O+O=C_{20}H_{26}N_2O_4$.

Action of Fremy's Osmiamide upon Animal Tissues.—Ph. Owsjannikow.—This paper is devoted to the description of the action of Fremy's osmiamide upon tissues, viz., for microscopico-histological use, and has nothing to do with chemistry. What Fremy's compound is meant is not stated.

Comptes Rendus des Séances de l'Académie des Sciences, March 14, 1870.

The number contains the following original papers relating to chemistry and allied sciences:—

Photographical Observation of the Passage of Venus, and on an Apparatus of M. Laussedat.—M. Faye.—Owing to the general importance of this lengthy memoir, we quote the title here.

On the Nascent State.—H. Sainte-Claire Deville.—Continuation of a former paper on this subject, and, like the first instalment, unsuitable for any useful abstraction. There are added to this paper several tabulated forms containing the results obtained.

General Theory of Chemical Action.—E. J. Maumené.—A memoir on this subject was read at the meeting, but is not published.

Experiments on the Velocity of the Propagation of Sound in Water contained in an Iron Tube of 0·8 Metre (31·496 Inches) Diameter.—F. André.—The author describes, minutely, the arrangements made for conducting his experiments, and states that, while the temperature of the water, which entirely filled the tube, was 20° at the top end of the tube and 13° at the lower, the temperature of the air being 18°, he found, as the result of his experiments, that the velocity of the sound per second of time was 897·8 metres. Dr. Wertheim deduced, from his experiments with brass organ-pipes, that the velocity of propagation of sound in water was 1173 metres for the same space of time. MM. Colladon and Sturm, while experimenting on this subject on the Lake of Geneva, found the velocity 1435 metres for a second of time.

Mechanical Properties of Steel Containing Phosphorus.—L. Gruner.—The results arrived at by this author may be summarised as follows:—Phosphorus present in steel in a quantity of from 0·002 to 0·003 causes the metal to be rigid; it tends even to increase the elasticity and the resistance to breaking, but does not modify the hardness. Such steel, however, is wanting in real strength and toughness; it is brittle (*aigre*)—that is to say, does not withstand shocks. The general result is, therefore, that even very small quantities of phosphorus present in steel do not only not improve, but certainly deteriorate, its good qualities. Prof. Boussingault concurs in this view, and stated at the meeting that Dr. Salet, the chief assistant to Prof. Wurtz, has arranged an ingeniously-constructed apparatus to detect the smallest possible quantity of phosphorus in iron and steel, by means of the spectrum produced by the combustion of the hydrogen obtained by the action of chlorhydric acid on the metal.

Revue des Cours Scientifiques de la France et de l'Etranger, No. 15, March 12, 1870.

This number contains an excellent paper—

Lecture on the Shape and Figure of our Globe.—C. Wolf.—The contents of this paper, although not belonging to the sciences usually treated of by us, deserves the attention of all who wish to read a clear and concise account of the highly-refined scientific methods brought to bear upon the determination of the shape of the globe we inhabit. The author forgets to mention that the first measurement of a portion of a meridian arc ever made was executed very early in the seventeenth century by the celebrated mathematician, Simon Stevin, the teacher of Prince Maurice of Orange, and the inventor of carriages moved by the force of the wind, aided by sails. To Dominico Cassini is due the honour of having first suggested triangulations.

We also learn from this paper that the well-known physicist, Dr. Lallemand, has been transferred from the University of Montpellier to that of Poitiers, to fill the chair left vacant by the death of Dr. Tronessard there.

March 19, 1870.

This number does not contain any papers relating to chemistry, but we quote the titles of two excellent lectures published here, viz.:—

On the Evolution of Scientific Medicine and its Present State.—Dr. C. Bernard; and—

Man of the Tertiary Period in America, and the Theory of Multiple-Centres of Creation.—M. Hamy.

Cosmos, March 12, 1870.

Modification of Fortin's Barometer.—A. Amagat.—Instead of the movable bottom to the mercury cup of these barometers, the author displaces the mercury of the reservoir, by means of an iron or glass cylinder, which is forced down into the fluid by the aid of a screw. By this arrangement, the movable bottom (a strong skin) to the mercury cup, or reservoir, is dispensed with.

Fresh Butchers' Meat from America to Europe.—Herrera Yobes.—This author proposes to have the hold of vessels lined with metal (what kind of metal is not stated); the bottom of the hold is next covered with either clean straw, saw-dust, or bran, or any other suitable non-conductor of heat. Upon these, the freshly-killed and cut-up meat is placed, and on the top thereof a layer of ice, and on the top of that, again, straw or any of the other substances just named, and next, again, meat and ice, and so on; and after the hold has been thus filled, it is hermetically closed and suitably protected from the effects of hot weather during the journey from Montevideo to Europe.

Consumption of Albumen for Industrial Purposes.—It is a well-known fact that certain industries consume a very large quantity of albumen in some shape or other; sugar refiners, tawers, glove leather makers employ albumen in more or less pure state—in some instances the yolk of eggs only; but the calico-printers are the largest consumers, and this consumption is steadily on the increase. The printing works of the Alsace alone consume annually more than 150,000 kilos. of dried albumen, representing rather more than 37,000,000 of eggs, or the production of 250,000 hens; add to this the consumption of the printing works of other parts of France and of other countries, and there is very little doubt that annually some 150,000,000 eggs are used for that purpose alone.

March 19, 1870.

Amelioration of Wines by Electricity.—Dr. Scoutetten.—As a very tangible proof of the gain obtained by the immediate conversion of young wines into drinking beverages by means of electricity, the author states that, considering that the annual production of wine of France amounts to from 60 to 70 millions of hectolitres (each equal to rather more than 22 gals.) and that at least 10 francs per hectolitre is lost by vapourisation during the time of the maturing of the wine while in casks, this represents a number of from 600 to 700 millions of francs gained by rendering wine fit for immediate consumption by the author's electric process. We may, not inaptly apply here—"Si non e vero e bene trovato."

NOTES AND QUERIES.

Refractive Power of Saline Solutions.—In Chemical News, vol. xiv., p.156 (*Eng. Ed.*), there is a short note, from *Les Mondes*, "On the Refractive Power of Saline Solutions." Can any of your readers refer me to any recent English work or detailed note on the subject?—P.

Bavarian, Vienna, and Belgian Beers.—Messrs. Zacherl and Degelmeyer.—Munich holy father beer—Sp. gr., 103; alcohol, 4·9; extract, 13·0; carbonic acid, 0·08. Bock beer—Sp. gr., 1·02; alcohol, 8·9; extract, 8·5; carbonic acid, 0·08. Salvator beer—Sp. gr., 1·02; alcohol, 4·2; extract, 8·1; carbonic acid, 1·2. Vienna beer (old)—Sp. gr., 1·012; alcohol, 5·2; extract, 5·0; carbonic acid, 1·5. Vienna double beer—Sp. gr., 1·026; alcohol, 5·2; extract, 7·8; carbonic acid, 1·8. Lambiek, Bruxelles—Alcohol, 4·7; extract, 3·4. Other variety (same name)—Sp. gr., 1·004; alcohol, 5·5; extract, 3·4; carbonic acid, 2·0. Faro beer, Brussels—Sp. gr., 1·005; alcohol, 4·9; extract, 3·0; carbonic acid, 2·0. Brunswick mumme—Sp. gr., 1·231; alcohol, 3·6; extract, 47·6; carbonic acid, 1·2. Beer brewed at Utrecht—Alcohol, in 100 parts by volume, 5·4; acetic acid, in 100 parts by volume, 0·016; lactic acid, in 100 parts by volume, 0·35; carbonic acid, in 100 parts by volume, 0·159; extract, in 100 parts by weight, 3·49; ash, in 100 parts by weight, 0·36; albumen, in 100 parts by volume (calculated for 15·5 N), 0·46. Beer from Middelburgh—Alcohol (by bulk), 4·95; albuminous compounds, 0·83; sugar, dextrine, and extract, 3·67; ash, 0·42; lactic acid, 0·26; acetic acid, 0·02; carbonic acid, 0·10.

Estimating the Amount of Lamp-Black in Graphite.—Will any of

your readers kindly inform me, if there is any accurate method by which the amount of lamp-black may be estimated in samples of graphite adulterated with it.—J. Reddrop.

Coprolite and Bone in Mixed Superphosphates.—Can any one give me a process to quantitatively determine the relative amounts of coprolite and bone in a mixed superphosphate?—W. M. B.

Money-Values of Substances Found in Artificial Manures.—I have occasional applications made to me to add to my certificates of analysis of manurial substances the "value at prices fixed by chemists." I have not done so, for the twofold reason that (1) I do not consider it within the province of the analyst, and (2) that I do not know what the prices are. Can any one, therefore, kindly inform me if this custom obtains amongst respectable analysts? and, if so, what are the various money-values of the substances found in the artificial manures now in use?—W. M. B.

Removing Silica.—Can any of your readers inform me of a practical mode of removing silica from large quantities of carbonate of potassium?—W. H.

Colours and Pigments.—(Reply to "A Reader, Church, near Accrington.")—There are not many works on the subject you refer to. One of the best is "Lehrbuch der Farben Fabrikation, &c., &c.," von T. G. Genteb (Brunswick: Vieweg and Son, 1860). As to the manufacture of blood and egg albumen, you mean, of course, the preparation of these articles in dry state, fit for preservation; and, for information thereupon, we refer you, among other works, to Schützenberger's "Traité des Couleurs," and to Persoz's "Traité de l'Impression des Tissues."

Distilling Tar.—Consult "Coal, Petroleum, and other Distilled Oils," by Dr. Gesner (New York, London, and Paris: Baillière, 1861; later edition in 1865), and "Industrie der Mineralole des Petroleums, Paraffins, und der Harze," von H. Perutz (Wien, 1868); also "Chemical Technology, or Chemistry in its Applications to the Arts, &c."

Anthracene.—I should be glad to have a simple test for commercial anthracene, and its price, to see whether it would be worth while to make it where pitch is of little value?—Tar Distiller.

Coprolite and Bone in Mixed Superphosphates.—(Reply to "W. M. B."—When both the bones and coprolites have been thoroughly dissolved, it will be almost impossible to determine what you desire. If no ammonia salts are present, and the bones applied not too strongly boiled (exhausted by steam), you might (after drying, of course, at 120° C.) get some idea by means of the nitrogen estimation.

Estimating the Amount of Lamp-Black in Graphite.—(Reply to J. Reddropp.)—In the first place, you might make use of the considerable difference of specific gravity of these two substances, and thus separate them from each other by lixiviation. Since lamp-black (unless purposely purified or re-calcined) always contains a certain amount of empyreumatic matter, you might extract the graphite you suspect with boiling alcohol (methylated spirit will not do in this case), and come to some idea of the amount of lamp-black added to your graphite by the weight of the empyreumatic matter left after complete exhaustion with alcohol and evaporation of the latter. When completely exhausted, an aqueous solution of boiling caustic soda should not, after the graphite (supposed to be mixed as alluded to) has been quietly settled down, exhibit any sign of brownish or yellowish brown colouration.

Manufacture of Sulphuric Acid.—The following practical objections to Dr. Hofmann's paper, abstracted by you from the *Berichte der Deutschen Chemischen Gesellschaft*, are suggested by my experience, and I should like to elicit the opinions of others who have had experience in that manufacture. If the steam is regulated so as to make the acid of 1·676 to 1·714 sp. gr., as Dr. Hofmann proposes, there is so much nitric oxide dissolved in it as to act very energetically on the lead of the chamber, the liquor in the gauge-drips becoming thick with sulphate of lead, whilst, as a consequence, the chamber wears out very rapidly. At the same time, if the condensed acid in the saucer of the chamber is drawn off at such a high specific gravity, I find that the dissolved nitric oxide is not got rid of by the subsequent boiling, but that the concentrated oil of vitriol gives off abundant red fumes when diluted, causing great inconvenience to those who use it, and, of course, a waste of nitric acid.—H. B. Gibbins.

Analysis of Superphosphates.—Perhaps some of your numerous correspondents would explain to me how it is that, in the analysis of superphosphates and other phosphatic manures, biphosphate of lime is put down as one of the ingredients it contains, and generally underneath it is placed equal to so much phosphate of lime made soluble. Now, I always understood there was no such substance as biphosphate of lime in a superphosphate, but that the phosphates it contained existed as monocalcic phosphate or soluble phosphate, and tricalcic or insoluble phosphate, and not as biphosphate. If such is the case, why not simply put in the analyses the amount of soluble phosphate, or, if I am wrong, the amount of biphosphate, and not put both? This would simplify matters greatly, as, at present, people that have only a limited knowledge of chemistry are very apt to confound the one with the other, not knowing the difference between them.—R. Holmes, Roscommon, Ireland.

Liq. Ammoniæ.—How and what kind of apparatus is used for making Liq. Ammon. Fort. (880), as I want to use some of that strength daily, to make about 2 cwts. of it at once?—J. Spencer.

Baumé's Hydrometer.—How may I gain a knowledge of the comparison which the common specific gravity glass bears to Baumé's hydrometer and specific gravity glass?—J. T. E.

Alumina.—Can any of your readers tell me whether pure alumina is to be obtained from any source? I have heard that it exists somewhere in Cornwall under the name of "Wavellite," but I can learn no more.—Arthur Warner.

Basic-Salt of Iron.—When a solution of $FeSO_4$ is exposed to the air until no further change occurs, what is the formula of the basic-salt precipitated, and of the acid-salt remaining in solution?—Ferrous Sulphate.

Dr. Schiebler's Apparatus.—I see that mention is made by Mr. Arnot, in his articles on "Sugar Refining," of Dr. Schiebler's apparatus for the amount of carbonates. I cannot find any description of it in the last edition of Fresenius nor in Griffin's "Chemical Handicraft." Can he give me some idea of the instrument, its price, where procurable, and if applicable for the amount of mineral carbonates?—W. R.

Dissolving Cellulose, &c.—(1) Are there any special conditions required, so that cellulose may dissolve in the ammonia solution of copper, or silk in chloride of zinc? (I kept the latter at about 100° F.) (2) Are there any other solvents easily separated from the colloid, suitable for making the latter give a tenacious film? (The film is required transparent, tough, insoluble in water and unaffected by moderate heat, conditions which the enclosed specimen possesses, but for the objections in its preparation and the expense). (3) Can you give me a cheap method of destroying the smell of methylated spirit? (4) Is there any substance that will render gelatine insoluble in clear, transparent sheets besides the bichromates of ammonia and potash and alum?—Bichromate.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

Kalium.—Perchloric acid is in very small demand. The demand for permanganate of potassium is considerable: Messrs. Condy and Co., Battersea, are the principal makers.

J. W. S. and others.—We shall be glad if you will forward replies for "Notes and Queries" in such a form that they can be printed in the Journal. We do not wish a query publicly made to be privately answered.

James Power.—A work on the subject by the Editor is in the press.

Professor Charles A. Cameron; Dr. A. W. Hofmann, F.R.S.; H. N. Draper; Dr. Moore; John Pattinson, F.C.S., are thanked for their communications, which shall receive early attention.

T. Y.—Consult the Index; you will find communications on the subjects you name.

C. D. H.—H. Baillière, of 219, Regent Street, or any foreign bookseller.

Capt. W. A. Ross, R.A.—In our issue of December 3rd, 1869 (*Am. Repr., Feb.*, '70, *page* 116), we expressed our regret at not having space for your articles. The great demand on our space obliges us to omit articles which appear to be of but little interest to our readers.

A. Freire-Marreco.—When the papers are of great length we should prefer a condensed report, but when important we will always endeavour to insert them unabridged.

Prof. J. Lawrence Smith.—The receipt of your letter was acknowledged in our columns, and your request has been attended to by our publisher.

Inquirer.—The unabridged edition of "Fresenius" is evidently the best.

M.R.C.S.—Calley's "Practical Telegraphy" will answer your purpose well.

C. R. Stevens.—A work on Dyeing, by the Editor of this paper, is in the press.

C. A. Grant.—(1) We do not know the names and addresses of makers of liquid fuel. (2) The Society of Arts, John Street, Adelphi. (3) We have no printed documents; consult *Engineer* or *Engineering*.

A Subscriber.—The subject is not suitable for our Notes and Queries column; you had better advertise for the information.

The report of the Chemical Section of the Glasgow Philosophical Society arrived too late for insertion in this week's number.

B. Silliman.—Received with thanks.

Metallurgist.—Copper should be perfectly pure; any alloy injures its conductivity.

Prof. C. F. Chandler.—Received with thanks.

Books Received.—"General-Versammlung der Deutschen Chemischen Gesellschaft zu Berlin am December 11th, 1869." From Dr A. W. Hofmann, F.R.S. "Annual Report of the Progress of Pharmacy." "Transactions of the Newcastle Chemical Society." "On the Absorptive Power of Soil," by Robert Warington, F.C.S.; reprinted from "Practice with Science," vol. ii., 1869. "The Food Journal" for March. "The Sugar-Cane" for March. "On the Influence of Mental Activity on the Excretion of Phosphoric Acid by the Kidneys," by Luther Hodges Wood, Ph.B., M.D. "Midland Steam Boiler Inspection and Assurance Company:" Chief Engineer's Report with Records of Boiler Explosions, 1869. "Catalogue of Chemical Manufacturers' Machinery, Plant, &c.," as made by Robert Daglish and Co., St. Helen's Foundry, Lancashire: 1870: red cloth. "The Week of Creation, or the Cosmogony of Genesis considered in its Relation to Modern Science," by George Warington. London: Macmillan and Co. "The Fuel of the Sun," by W. Mattieu Williams, F.C.S. London: Simpkin, Marshall, and Co.

AMERICAN SUPPLEMENT.

New York, May, 1870.

Poisonous Cosmetics.

In December last, Dr. Lewis A. Sayre enclosed to Dr. Harris, Sanitary Superintendent of the Metropolitan District, a pamphlet, in which he described three cases of lead palsy produced by Laird's Bloom of Youth. This communication was laid before the Board of Health, together with notes from Dr. Harris and Sanitary Inspector Dr. Janes, in which attention was called to the great variety and large quantities of poisonous hair dyes, commonly called hair restoratives, etc., consisting essentially of acetate of lead, and enamels consisting of carbonate of lead, which were sold in the Metropolitan District.

The Board at once directed the Chemist to investigate the subject, and his report, which is here presented, fully confirms the opinions of the physicians. It was found, however, in the course of the investigation, that Laird's Bloom of Youth, the original cause of the investigation, no longer consisted of carbonate of lead, but was composed of oxide of zinc. As soon as this was established by the report, the proprietor, who had admitted to the writer that his preparation had formerly consisted of a lead compound, complained with an air of injured innocence that the Board of Health *had inflicted a great wrong upon him, had almost ruined his business.* Articles have been inserted in the daily papers, in the interest of the Bloom of Youth, which reflect upon the Chemist to the Board, as though he had wantonly, or by mistake, attacked an innocent citizen, and interfered with an honest business. We hold that inasmuch as the Bloom of Youth has been for years composed of carbonate of lead, and we know this of our own knowledge, as a bottle was purchased about two years ago, at a drug store on Broadway, and tested at the School of Mines, which had this composition, and as, according to Dr. Sayre and Dr. Hammond, this preparation had produced lead palsy, the proprietor of the article has no just claim for sympathy, even though he has finally, after so much harm has been done, changed its poisonous character.

Report of Prof. C. F. Chandler to the Metropolitan Board of Health.

Col. Emmons Clark,
Secretary Metropolitan Board of Health.

Sir:—In response to the resolution of the Board, directing "the Chemist to examine the various hair tonics, washes, cosmetics, and other toilet preparations in general use, and to report what ingredients, if any, they contain of a character injurious or dangerous to those who use them," I beg leave to submit the following report of the results thus far reached. My examination has been specially directed to the mineral poisons; no tests have been as yet made for vegetable or animal substances, as, for example, cantharides, which I have reason to believe is sometimes employed.

The articles which I have examined may be classed as—

I. Hair tonics, washes, and restoratives.
II. Lotions for the skin.
III. Enamels.
IV. White powders for the skin.

I. Hair Tonics, Washes, and Restoratives.

Of these sixteen have been examined, and, with but one exception, all have been found to contain lead, generally in the form of acetate or sugar of lead.

1. *Hyt's Hiawatha Hair Restorative.* David Wright, Proprietor, 112 South street, New York.

This is an ammoniacal solution of nitrate of silver, containing 4·78 grains of the nitrate in one fluid ounce. It contains no other metals.

2. *Clark's Distilled Restorative for the Hair.* C. G. Clark & Co., Proprietors.

This preparation contains in one fluid ounce:

Lead in solution	0·11 grains.

3. *Chevalier's Life for the Hair.* Prepared by S. A. Chevalier, M.D., 1123 Broadway, New York.

One fluid ounce contains:

Lead in solution	0·22 grains.
Lead in the sediment	0·80 "
Total lead	1·02 "

4. *Pearson & Co.'s Circassian Hair Rejuvenator.* J. S. Pearson & Co., 286 Jay street, Brooklyn, N. Y.

One fluid ounce contains:

Lead in solution	1·40 grains.
Lead in the sediment	1·31 "
Total lead	2·71 "

5. *Ayer's Hair Vigor.* Prepared by J. C. Ayer & Co., Lowell, Mass.

One fluid ounce contains:

Lead in solution	2·81 grains.
Lead in the sediment	0·08 "
Total lead	2·89 "

6. *Prof. Wood's Hair Restorative.* O. J. Wood & Co., 444 Broadway, New York.

One fluid ounce contains:

Lead in solution	2·93 grains.
Lead in the sediment	0·15 "
Total lead	3·08 "

7. *The Hair Restorer of America.* Prepared by Dr. J. J. O'Brien, 202 East 30th street, New York.

One fluid ounce contains:

Lead in solution	3·28 grains.

8. *Gray's Celebrated Hair Restorative.* Day, Hoagland & Stiger, 54 Courtlandt street, New York.

One fluid ounce contains:

Lead in solution	a trace.
Lead in the sediment	3·39 grains.
Total lead	3·39 "

9. *Phalon's Vitalia.* Prepared by Phalon & Son, 517 Broadway, New York.

Consists of two fluids in separate bottles.

No 1 is a clear, pale yellow solution of hyposulphite of soda.

No. 2 is a clear, pale pink solution, containing in one fluid ounce:

Lead	14·08 grains.

As, by the directions which accompany the package, the lead solution is to be diluted with twice its volume of the hyposulphite solution, the strength of the mixture would be reduced to one-third, when it would contain 4·69 grains of lead in one fluid ounce. Prof. Lawrence Reid, the manufacturers' chemist, claims that the hyposulphite of soda renders the lead harmless by ultimately forming with it an insoluble sulphide of lead, and in various other ways. But after carefully considering all his arguments, I am compelled to say that I cannot accept them as valid.

10. *Ring's Vegetable Ambrosia.* E. M. Tubbs & Co., Proprietors, Peterboro, N. H.

One fluid ounce contains:

Lead in the solution	4·69 grains.
Lead in the sediment	0·31 "
Total lead	5·00 "

11. *Mrs. S. A. Allen's World's Hair Restorer.* 198 and 200 Greenwich street, New York, and 266 High Holborn, London, England.

One fluid ounce contains:

Lead in solution	5·26 grains.
Lead in the sediment	0·31 "
Total lead	5·57 "

12. *L. Knittel's Indian Hair Tonique.* Louis Knittel, 616 Eighth avenue, New York.

One fluid ounce contains:

Lead in solution	5·16 grains.
Lead in the sediment	1·13 "
Total lead	6·29 "

13. *Hall's Vegetable Sicilian Hair Renewer.* R. P. Hall & Co., Nashua, N. H.

One fluid ounce contains:

Lead in solution	6·45 grains.
Lead in the sediment	0·68 "
Total lead	7·13 "

14. *Dr. Tebbett's Physiological Hair Regenerator.* Tebbett Bros., Proprietors, Manchester, N. H.

One fluid ounce contains:

Lead in solution	6·82 grains.
Lead in the sediment	0·62 "
Total lead	7·44 "

15. *Martha Washington's Hair Restorative.* Prepared by Simonds & Co., Fitzwilliam, N. H.

One fluid ounce contains:

Lead in solution	3·01 grains.
Lead in the sediment	6·79 "
Total lead	9·80 "

16. *Singer's Hair Restorative.* Depot, 643 Broadway, and 79 Nassau street, New York.

One fluid ounce contains:

Lead in solution	0·15 grains.
Lead in the sediment	16·24 "
Total lead	16·39 "

Recapitulation.—Only one of this class of preparations is free from lead, which metal seems indeed to be the *essential constituent* in most cases. Most of the sediments observed in the bottles, and which require that the bottle "*be well shaken*," etc., consist of sulphur, which it is intended shall ultimately unite with the lead to produce the dark-colored sulphide of lead, or, as one of the manufacturers has it, "*the original youthful beauty and color.*" The following tabular statement shows how the poisonous hair nostrums compare among themselves:—

Grains of Lead in one fluid ounce.

1. Clark's Distilled Restorative for the Hair	0·11
2. Chevalier's Life for the Hair	1·02
3. Circassian Hair Rejuvenator	2·71
4. Ayer's Hair Vigor	2·89
5. Prof. Wood's Hair Restorative	3·08
6. Dr. J. J. O'Brien's Hair Restorer of America	3·28
7. Gray's Celebrated Hair Restorative	3·39
8. Phalon's Vitalia	4·69
9. Ring's Vegetable Ambrosia	5·00
10. Mrs. S. A. Allen's World's Hair Restorer	5·57
11. L. Knittel's Indian Hair Tonique	6·29
12. Hall's Vegetable Sicilian Hair Renewer	7·13
13. Dr. Tebbett's Physiological Hair Regenerator	7·44
14. Martha Washington Hair Restorative	9·80
15. Singer's Hair Restorative	16·39

II. Lotions or Washes for the Complexion.

1. *Burnett's Kalliston.* Joseph Burnett & Co., Boston, Mass. Contains no injurious metals.

2. *Phalon's Paphian Lotion, or Floral Beautifier.* Phalon & Son, 517 Broadway, New York. Contains no injurious metals.

3. *Enamel of America.* François Gregoire & Co., cor. of Eighth and Locust streets, Phila. A clear colorless liquid, containing no injurious metals.

4. *Email de Paris, de Jared.* Jared et René, Paris. A pink alcoholic liquid, free from injurious metals.

5. *Balm of a Thousand Flowers.* A thick yellow emulsion, free from injurious metals.

6. *Perry's Moth and Freckle Lotion.* Dr. B. C. Perry, 49 Bond street, New York.

A colorless liquid, with a little white sediment.

One fluid ounce contains:

Mercury in solution	2·67 grains.
Zinc " "	0·99 "

Equivalent to—

Corrosive sublimate	3·61 "
Sulphate of zinc (crystallized)	4·25 "

The sediment contains a little mercury, lead, and bismuth.

Recapitulation.—With the exception of Perry's Moth and Freckle Lotion, these lotions are entirely free from lead or other injurious metals.

III. Enamels for the Skin.

1. *Balm of White Lilies, for preserving and beautifying the skin.* H. A. Hoadley, New York.

Water colored pink, and holding in suspension a large amount of carbonate of lime. It does not contain any injurious metals.

2. *Dr. Bradford's Enameline for the Complexion.*

A colorless liquid, holding 33·02 grains of oxide of zinc in suspension in each fluid ounce. Is free from lead.

3. *Hagan's Magnolia Balm.* Demas Barnes & Co., New York.

A colorless liquid, holding in suspension in each fluid ounce 118·61 grains of oxide of zinc. Is free from lead.

4. *Laird's Bloom of Youth, or Liquid Pearl.* Geo. W. Laird, 74 Fulton street, New York.

A colorless liquid, holding in suspension in each fluid ounce 169 grains of oxide of zinc. It is entirely free from lead.

5. *Eugénie's Favorite.* M'lles T. & L. Jouvin, late of Rue St. Anne, Paris.

A colorless solution, holding in suspension in each fluid ounce 140·52 grains of carbonate of lead, *white lead*, containing 108·94 grains of metallic lead. There is a trace of lead dissolved in the liquid.

6. *Snow-white Enamel for Whitening and Beautifying the Complexion.* Phalon & Sons, 517 Broadway, New York.

A colorless liquid, holding in suspension in each fluid ounce 186·67 grains of carbonate of lead, equivalent to

Metallic lead in sediment	144·72 grains.
Lead in solution	1·56 "
Total lead	146·28 "

7. *Snow-white Oriental Cream, for Whitening and Beautifying the Complexion.* Phalon & Sons, 517 Broadway, New York.

A colorless liquid, holding in suspension in each fluid ounce 246 grains of carbonate of lead; equivalent to

Lead in suspension	190·22 grains.
Lead in solution	0·77 "
Total lead	190·99 "

Recapitulation.—The Enamels consist of white powders suspended in clear liquids; on standing the powders subside, but agitation quickly incorporates them with the liquids again. The following contain lead, mostly, if not entirely, in the form of *carbonate;* they are therefore simply "white lead" ground in water.

Grains of Lead in one fluid ounce, after shaking.

Eugénie's Favorite	108·94 grains.
Phalon's Snow-white Enamel	146·28 "
Phalon's Snow-white Oriental Cream	190·99 "

IV. White Powders for the Skin.

1. *John Irvine's Compound Chinese Tablet of Alabaster* consists of carbonate of lime, free from injurious metals.

2. *Shand's Compound Chinese Tablet of Alabaster* consists of carbonate of lime, free from injurious metals.

3. *Superior Lily White,* X. Bazin, Philadelphia, consists of carbonate of lime and carbonate of magnesia, free from injurious metals.

4. *Cascarilla de Caracol de Persia,* R. & C. A. Wright, Philadelphia, consists of carbonate of lime, and some earthy matter insoluble in acids, either clay or "French chalk;" is free from injurious metals.

5. *The Original Tablet of Alabaster, or Lily White Cosmetic,* consists of carbonate of lime, with some clay or "French chalk;" is free from injurious metals.

6. *Bismuth Powder for Beautifying the Skin and removing Freckles* consists of carbonate of lime, with much clay or "French chalk;" is free from injurious metals.

7. *Lavel's Lily White and Rose Bloom* consists of clay or "French chalk;" is free from injurious metals.

Recapitulation.—The white powders consist of carbonate of lime, carbonate of magnesia, clay, or "French chalk;" either singly or mixed. Nothing injurious was detected in any one of them.

Conclusion.—It appears from the foregoing:—

1. The Hair Tonics, Washes, and Restoratives contain lead in considerable quantities; that they owe their action to this metal, and that they are consequently highly dangerous to the health of persons using them.

2. With a single exception, Perry's Moth and Freckle Lotion, which contains corrosive sublimate, the Lotions for the skin are free from lead and other injurious metals.

3. That the Enamels are composed of either carbonate of lime, oxide of zinc, or carbonate of lead, suspended in water. The first two classes of enamels are comparatively harmless, as harmless as any other white dirt when plastered over the skin to close the pores and prevent its healthy action. On the other hand, the enamels composed of carbonate of lead are highly dangerous, and their use is very certain to produce disastrous results to those who patronize them.

4. The white powders for the skin are harmless, except in so far as their application may interfere with the healthy action of the skin.

Respectfully submitted,
C. F. Chandler, Ph.D.,
Chemist to the Metropolitan Board of Health.

The Various Methods for the Determination and Separation of Baryta, Strontia, and Lime.

by paul schweitzer, ph.d.

(Continued from the April Number.)

III. *Determination of Lime.*

Lime is generally precipitated from its solutions as sulphate, carbonate, or oxalate of lime, and weighed as either sulphate, carbonate, or caustic lime. In the latter case, five minutes over a good blast-lamp will generally be sufficient to free each decigramme of lime from all carbonic acid; a second test will, however, always be necessary. Several treatises on this and other related subjects have lately been published, of which I will mention J. Fritzsche, Zeitschrift für Analytische Chemie, 3 Jahrgang, p. 177; and Alfonso Cossa, the same Zeitschrift, 8 Jahrgang, p. 141, whose results show the comparative value of some of the determinations of lime and the modes of best applying them. From the character of the relation existing between the three alkaline earths we may infer beforehand that the precautions to be observed in the precipitation and determination of baryta and strontia have to be also observed with lime. The same affinities exist between its salts and those of the alkalies, though somewhat modified; for while baryta and strontia, principally in combination with strong acids, combine with and retain alkaline salts, the latter are taken up to a much larger extent by salts of lime, in combination with a weak acid. This affinity of the three alkaline earths to salts of alkalies extends to other oxides also, and is the probable cause of the non-metamorphic crystalline as well as massive deposits of lime containing always some, and often a considerable amount of impurities. These impurities we find also in the metamorphosed

gypsum; while the sulphates of baryta and strontia, which are precipitated directly from their solutions, are comparatively much purer. All three alkaline earths can exist, under certain conditions, in solution with alkaline carbonates and sulphates. These conditions being removed, as for example in the case of a spring reaching the surface of the earth, heat and pressure disappear, the sulphate of baryta is precipitated directly, with little or no impurities (sulphate of strontia), while strontia and lime salts are carried off. Soon the bicarbonate of strontia loses carbonic acid, and, in case sulphates are present, is precipitated as sulphate of strontia with the last traces of baryta, and, depending on the basin, in which this deposition occurs and the nature of its outlets, with or without sulphate of lime. In the absence of alkaline sulphates, carbonate of strontia will be deposited invariably with carbonate of lime; while the dissolved carbonate of lime, as it flows from a deposit of sulphate or carbonate of strontia, will either be totally free from or contain carbonate of strontia. These generalizations would lead me too far, but deductions drawn from the consideration of the small amounts of impurities, as they exist in all well-characterized minerals, seem to me to promise valuable results, especially as regards geology.

For the following determinations a pure carbonate of lime was used, that showed before the spectroscope no traces of other alkaline earths nor of the alkalies. It was weighed as caustic lime, and the weight given as carbonate, in order to be in accord with the other determinations. It was proved by experiment that the weight of carbonate of lime represented the exact amount taken.

Sulphate of Lime.

The caustic lime was dissolved in a platinum dish in hydrochloric acid, and the solution evaporated on a water-bath, until acid fumes could be no longer detected. This solution was then transferred to a beaker glass and diluted to the proper volume, after which a sufficient amount of dilute sulphuric acid and twice the volume of alcohol was added. After standing for about two days, the voluminous precipitate of hydrous sulphate of lime was filtered on a weighed filter, and washed with alcohol until neither hydrochloric nor sulphuric acid could be detected in the filtrate. Even then, as in the case of baryta and strontia, it contained traces of free sulphuric acid, which was proved by the carbonization of parts of the filter-paper on subsequent drying. The precipitate was then dried over sulphuric acid, and finally in an air-bath, with a view to a possible indirect determination of lime and one other alkaline earth, before it was ignited in the usual way. Two determinations were made in this way with the following result:—

A.		B.	
	1·2639 CaO,CO^2		1·2750 CaO,CO^2
yielded	1·7086 CaO,SO^3	yielded	1·7236 CaO,SO^3
=	1·2564 CaO,CO^2	=	1·2674 CaO,CO^2
=	99·41 p. c.	=	99·40 p. c.
—	0·59 p. c.	—	0·60 p. c.

The loss on drying was—1. after standing for seven days over sulphuric acid; 2. after two days longer; 3. after three hours in an air-bath at 212° F.; and 4. after four hours in the same bath; or rather the amount of water retained was the following:—

A.	B.
21·55 p.c.	21·99 p.c.
21·62 p.c.	21·90 p.c.
5·29 p.c.	12·19 p.c.
5·03 p.c.	11·33 p.c.

The formula $CaO.SO_3+2HO$ requires 20·93 p.c. of water. The precipitate of sulphate of lime will be reduced in volume by long standing, and washes out remarkably easily and quickly. The extent of its solubility in hydrochloric acid is sufficiently well known, and for this reason and its solubility in water alone, no analysis could be made to determine the amount of alkaline salts taken up. That alkaline salts, however, are taken up by sulphate of lime was determined in another way, namely, by precipitating, with all the precautions necessary, a solution of sulphate of potassa with chloride of calcium, and the addition of alcohol. In the two following analyses the alcohol was added to A, directly after the addition of the sulphuric acid, while B was allowed to stand for twenty-four hours before it was mixed with alcohol. The precipitates obtained in this way were totally different, as might have been expected. For while nothing precipitated at first, the gypsum commenced to crystallize out of B, so that the addition of alcohol afterwards produced only a slight cloudiness. It had then an apparent volume of one-half of that of A, could be filtered and washed quicker than A, and represented after ignition a light crystalline powder, not less in volume than the original, the crystalline form of which could be easily determined with the aid of a microscope. The amount of alkali taken up differs with the mode in which the gypsum has been produced, showing clearly that a certain length of time is necessary to effect the decomposition of one salt in solution by another. As additional examples I will mention the precipitation of very small amounts of sulphuric acid by a salt of baryta and other phenomena of this class, the gradual precipitation of carbonate of an alkaline earth from a solution of such carbonate in hydrochloric acid by ammonia and others.

The results are as follows:—

A.		B.	
	1·0550 $KO.SO^3$		1·0575 $KO.SO^3$
yielded	0·8263 $CaO.SO^3$	yielded	0·8241 $CaO.SO^3$
	=1·0585 $KO.SO^3$		=1·0557 $KO.SO^3$
	=100·33 p.c.		= 99·83 p.c.
	+ 0·33 p.c.		— 0·17 p.c.

Carbonate of Lime.

Carbonate of ammonia produces in solutions of lime a white, flocculent precipitate, which by boiling changes into a heavy, crystalline powder, which can be easily and quickly washed. It resembles in this respect carbonate of strontia, just as much as the sulphates resemble each other, both differing from the corresponding baryta salts. In the presence of alkaline salts, those are precipitated to some extent, and by washing such precipitate until no hydrochloric acid is found in the filtrate, make about two per cent. in addition. For the following three analyses, A and B without, C with, the addition of 6 grammes alkaline chlorides, the lime was dissolved in hydrochloric acid, ammonia added to alkaline reaction, and the boiling solution precipitated with carbonate of ammonia. The carbonate of lime may be dried and weighed as described under strontia; for though it is asserted that even a very low heat will drive out some carbonic acid, I could not satisfy myself as to the fact. The test with turmeric paper I applied myself several times to such dried precipitate, without being able to detect any difference between this and well-washed and pure air-dried carbonate of lime. The results of the analyses also prove the accuracy of the method. In the presence of alkaline car-

bonates, drying will, in the same way, show a higher percentage than the determination as caustic lime or sulphate of lime; but the results will be lower, and the difference amounts to exactly the weight of carbonic acid that corresponds to the alkali retained. Whether this is accidental, or whether the carbonate of lime loses at that temperature, and under the influence of the alkaline carbonate in combination with it or distributed through its whole mass, an equivalent portion of carbonic acid, I cannot yet decide. Certain it is that repeated heating in this way does not alter the first weight obtained. The results are as follows: 1. representing the weight after drying; 2. after heating for 15 minutes over the blast lamp; and 3. after 25 minutes' heating over the blast lamp:—

	A.	B.	C.
$CaO.CO^2$	1·1129 gr.	0·8181	1·1794
CaO	=0·6227 gr.	=0·4576	=0·6746
$CaO.CO^2$	=1·1120	=0·8173	=1·2046
	= 99·92 p.c.	= 99·90	=102·14 p.c.
	— 0 08 p.c.	— 0 10	+ 2·14 p.c.
1) $CaO.CO^2$	1·1111	0·8166	1·1975
	99·84 p.c.	99·82 p.c.	101·53 p.c.
2) CaO	0·6235		0·6755
$CaO.CO^2$	1·1134		1·2062
	100·13 p.c		102·28
3)	99·92 p.c.	99·90 p.c.	102·14

Oxalate of Lime.

The precipitation of lime as oxalate is in most cases resorted to, and gives results that are not surpassed in accuracy by any other method. The precipitated oxalate is best weighed as caustic lime wherever a good blast-lamp can be had, otherwise it is less troublesome to convert it into sulphate. It is a very tedious process to reconvert the ignited oxalate into carbonate, as was done with B. The amount of alkalies retained is very large; in the analysis of ores, therefore, that are subjected to a process of fusion with carbonate and nitrate of potassa or soda, the precipitated oxalate of lime must be dissolved once more in acid and re-precipitated, even in the absence of all magnesia. A and B were precipitated without, C after, the addition of 6 grammes alkaline chlorides. The results are as follows:

A.	B.	C.
1·8057 $CaO.CO^2$	0·9415 $CaO.CO^2$	1·6126 $CaO.CO^2$
2·4561 $CaO.SO^3$		2·2840 $CaO.SO^3$
1·8660 $CaO.CO^2$	0·9424 CaO,CO^2	1·6800 $CaO.CO^2$
100·02 p. c.	100·09 p. c.	104·18 p. c.
+ 0·02 p. c.	+ 0·09 p. c.	+ 4·18 p. c.

The precipitation of salts of strontia by chromate of potassa proves this method to be worthless as a means of separating it from baryta. A concentrated solution of chloride of calcium, as prepared according to Fresenius' qualitative analysis, will also have a precipitate of chromate of lime appearing after a few days, the amount of which was, however, not determined. As this finishes all the different modes of determining the three alkaline earths, I will take up in the next paper the modes of separating one from the other.

Bullion Product of the United States for 1869.

Rossiter W. Raymond, Ph.D., U. S. Commissioner of Mining, estimates the bullion product for 1869 as follows:—

California	$20,900,000
Nevada	14,000,000
Oregon and Washington	4,000,000
Idaho	7,000,000
Montana	12,000,000
Colorado and Wyoming	4,000,000
New Mexico	500,000
Arizona	1,000,000
All other sources	1,000,000
Total	$63,500,000

Commercial Test of Cotton-Seed Foots.

BY DR. I. WALZ.

The residues from the clarification of cotton-seed oil, the so-called "foots," are now quite generally used as "stock" in the manufacture of various kinds of soap, and I have lately had frequent occasion to test them for their commercial value in this connection. In this way I have become acquainted with an interesting difference between the "foots" obtained by the use of soda and of potash, both of which, however, contain substantially the same components, viz.: fatty acids, albumen, mucilage, alkali, and impurities.

I test the sodic foots in the following simple manner: 15 grammes or half an ounce of the material are boiled with 35 c.c. of water, to which a few drops of caustic soda are added in order to facilitate the solution. This being effected, 5 c.c. of strong hydrochloric acid are added, and the whole is poured into a burette which is kept for this special purpose. After the complete separation of the fatty acids from the liquid has taken place, the quantity of the former is read off in cubic centimetres, and compared with a sample of standard stock of known value which has been treated in the same manner.

The burette which I use for this purpose is so graduated that, using the quantities above given, every cubic centimetre of fatty acid indicates a value of ¼ cent in the pound of stock; so that an article, 15 grammes of which yield 12 c.c. of fatty acid, is worth 3 cents per pound.

At first I attempted to test the potassic foots in the same manner, but I found that the fatty stratum in this case generally measured 50–75 per cent. more for the same amount of material than for the soda stock,—a result which I knew could not possibly be correct. Its appearance also was never homogeneous, but, especially near the dividing line, indicated the presence of lumps of coagulated albumen. I succeeded, however, in obtaining perfectly concordant results by proceeding as follows: 15 grammes of the foots are boiled with 40 c.c. of water containing some caustic soda, and salt enough is then added to form a soda soap. The whole is allowed to stand 15–20 minutes, after which the soda soap will be found floating on the top of the lye. The latter is then carefully drawn off by means of a syphon, and the test of the residue proceeded with as above directed.

An Experiment to Demonstrate Increase of Weight in Combustion.

I notice in the February Number of the Chemical News, "An experiment to demonstrate increase of weight in combustion."

Believing that the method which I have been in the habit of employing to illustrate the same fact is superior to that described in the article referred to, I take the liberty to send it in, and, if you think it worth the space it will occupy, please insert it in the News. The experiment is as follows: Take a small quantity (say 5 or 6 grammes) of "Iron by Hydrogen" in a *thin* iron dish (a very small sand-bath), place it on the balance pan and counterpoise with weights. The fine iron can be lighted very easily with a match, and as it burns quietly the scale-pan will gradually descend, showing very clearly the increase in weight by oxidation.

D. H. Briggs.

Norton, Mass., March 26, 1870.

Adulterated Aniline Dyes.

To the Editor of American Supplement to Chemical News:

I have recently found a curious adulteration in aniline dyes, that may interest some of your readers.

It consists of fine granulated sugar, and each particle or crystal is so well covered with a thin film of the true aniline dye as to produce a very good imitation, in color and form.

The first instance was a case of sixty pounds of Hoffmann's Violet, which was sold for about six dollars per pound, without discovery. It contained more than half its weight of this colored sugar, the remainder being ordinary crystals of aniline violet.

These dyes have not been heretofore so extensively adulterated, and although this fraud may be easily detected, still it is a dangerous one, and one against which dyers and colorers should be cautioned.

S. Dana Hayes,
State Assayer, Mass.

Boston, Mass., April 21st, 1870.

Statistics of the Sugar Industry.

The following interesting tables are extracted from the admirable report on the *État de l'Industrie du Sucre*, by M. B. Dureau, editor of the *Journal des Fabricants de Sucre*. It was one of the Jury Reports of the Exposition Universelle of 1867.

Production of Beet Sugar in France, 1866–67.

Department.	No. of Factories.	Kilogrammes.	Pounds.	Per Cent.
Aisne	80	39,172,464	86,360,398	18·06
Nord	160	77,922,287	171,789,032	35·93
Oise	32	16,813,646	37,067,700	7·75
Pas-de-Calais	76	35,446,974	78,147,208	16·34
Somme	55	24,731,431	54,523,407	11·41
Other departments	38	22,767,875	54,194,512	10·51
Total	441	216,854,677	482,082,257	100·00

Total Production of Beet Sugar in 1866.

	Kilogrammes.	Pounds.	Per Cent.
France	216,850,000	478,071,847	32·14
Zollverein	192,500,000	424,389,350	28·53
Russia	100,000,000	220,462,000	14·83
Austria	100,000,000	220,462,000	14·83
Belgium	40,000,000	88,184,800	5·92
Poland	19,000,000	41,887,780	2·81
Holland	6,000,000	13,227,720	0·89
	674,350,000	1,486,685,497	100·00

Total Production of Sugar in 1867.

	Kilogrammes.	Pounds.	Per Cent.
Cuba (exportation)	530,000,000	1,168,448,600	22·72
Porto Rico (exportation)	60,000,000	132,277,200	2·57
Antilles, Eng., Danish Guiana	250,000,000	551,155,000	10·72
French Colonies	150,000,000	330,693,000	6·43
Louisiana	30,000,000	66,138,600	1·28
Mexico	32,000,000	70,547,840	1·37
Peru (exportation)	1,000,000	2,204,620	0·04
Brazil	130,000,000	286,600,600	5·57
Sandwich Islands	10,000,000	22,046,200	0·42
Spain	5,600,000	12,345,872	0·24
Port Natal	6,000,000	13,227,720	0·25
Queensland	500,000	1,102,310	0·02
China	14,200,000	31,305,604	0·61
Penang (exportation)	3,000,000	6,613,860	0·12
Siam	5,200,000	11,464,024	0·22
Java	130,000,000	286,600,600	5·57
East Indies (exportation)	24,000,000	52,909,880	1·03
Mauritius	100,000,000	220,462,000	4·29
Manilla (exportation)	60,000,000	132,277,200	2·57
Egypt (exportation)	10,000,000	22,046,200	0·43
Cane Sugar	1,551,500,000	3,420,467,930	66·47
Beet Sugar, Europe	650,000,000	1,433,003,000	27·87
Palm or Date Sugar	100,000,000	220,462,000	4·29
Maple Sugar, N. America	30,000,000	66,138,600	1·28
Total Sugar	2,331,500,000	5,140,071,530	100·00
Sorghum Syrup—gallons	18,000,000		

Recent Chemical Patents.

Issued March 22, 1870.

100,961.—Electro-Deposition of Metals.—Isaac Adams, Jr., Boston, Mass.

100,997.—Removing Colors from Leather.—E. S. Frye, Salem, Mass.

101,003.—Restoring Waste Alkali Used in Oil Refineries.—Wm. Goodain and Geo. Stead, Cleveland, Ohio.

101,009.—Extracting Copper from its Ores.—Nathaniel Haskell, San Francisco, Cal.

101,011.—Apparatus for Producing Sulphurous Acid.—Moritz Hatschek, Pesth, Hungary.

101,012.—Process and Apparatus for Treating Wood.—Ira Hayford, Boston, Mass.

101,019.—Apparatus for Cooling and Saving Charcoal.—G. A. Jasper, Charlestown, Mass.

101,048.—Treating Coal-Products to Obtain Benzole, etc.—John Rowley, Camberwell, England.

101,067.—Manufacture of Iron, and Apparatus therefor.—James Davenport Whelpley and Jacob Jones Storer, Boston, Mass.

101,075.—Electroplating Apparatus.—H. W. Wright, Taunton, Mass.

101,131.—Fertilizer.—H. A. Hogel, Brooklyn, N.Y.

101,193.—Manufacture of Soap.—Alexander Warfield, Alexandria, Va.

101,198.—Ice Machine.—Frank Windhausen, Brunswick, Germany.

Issued March 29, 1870.

101,213.—Apparatus for Tanning Leather.—O. W. Bean and W. B. Rowland, Tecumseh, Mich.

101,243.—Tanning.—Elihu England, Mossy Creek, Tenn.

101,248.—Preventing the Incrustation of Steam-Boilers.—J. T. Fisher, Pittsburg, Pa.

101,250.—Converting Articles made of Iron into Steel.—Hiram C. Folsom, Bangor, Me.

101,253.—Manufacture of Artificial Stone.—Aaron H. Frear, Chicago, Ill.

101,263.—Manufacture of Iron and Steel.—James Henderson, New York City.

101,264.—Tinning and Galvanizing Wire.—E. H. Hill, Worcester, Mass.

101,283.—Bleaching Dark Soap and "Foots."—Oscar Loew, N. Y. City.

101,284.—Method of Bleaching and Refining Oils.—Oscar Loew, N. Y. City.

101,291.—Manufacture of Cast Steel.—Hugh McDonald, Pittsburg, Pa.

101,319.—Process of Obtaining Acetic Acid from Wood.—Theodore Schwartz, N. Y. City.

101,320.—Treating Wood to Obtain Useful Products.—Theodore Schwartz, N. Y. City.

101,331.—Apparatus for Tanning Hides.—R. T. White, Winchester, Mass.

101,406.—Process of Preparing Paper for Roofing and Similar Purposes.—C. H. Smith, Baltimore, Md.

Issued April 5, 1870.

101,415.—Apparatus for Generating Carbonic Acid.—Benj. Bates, Baltimore, Md.

101,544.—Process and Apparatus for Supplying Pure Water to Buildings.—John A. Thompson, Auburn, N.Y.

101,553.—Process of Treating Wood.—S. P. Wheeler, Bridgeport, Conn.

101,555.—Combined Distilling Apparatus.—Ludwig Wolff, Chicago, Ill.

101,557.—Apparatus for Generating and Carburetting Hydrogen Gas.—J. S. Wood, Phila., Pa.

101,558.—Generating Hydrogen and Hydrocarbon Gas.—J. S. Wood, Phila., Pa.

101,624.—Manufacture of Steel.—O. E. Hunter, Keyport, N.J.

101,625 —Composition for the Manufacture of Friction Matches.—J. J. Karlen, Erlenbach, Switzerland.

101,654.—Desulphurizing Ores.—John F. Osgood, Boston, Mass.

101,661.—Tanning by Infiltration.—L. T. Robertson, N. Y. City.

Issued April 12, 1870.

101.783.—Manufacture of Sugar and Alcohol from Lichens.—Sten Stenberg, Stockholm, Sweden.

101,812.—Apparatus for Tanning by Infiltration.—J. G. Baker, Wilmington, Del.

101,861.—Composition of Matter called "Metaline," for Journals, Bearings, &c.—Stuart Gwynn, New York City. Antedated March 30, 1870.

101,869.—Process of Forming Compositions of Matter called "Metaline," for Journals, Bearings, Steps, and other Articles liable to Friction.—Stuart Gwynn, New York City. Antedated March 30, 1870.

101,876.—Apparatus for the Manufacture of Ice.—D. L. Holden, New Orleans, La.

101,935.—Treating Fatty Matter for the Manufacture of Candles.—Antoine Radisson St. Cyr, Lyons, France.

101.964.—Burning Petroleum and other Hydrocarbon Oils.—L. E. Truesdell, Warren, Mass.

Reissues.

3,884.—Manufacture of Glue.—George Guenther, Chicago, Ill., and E. H. Neymann, N. Y. City.

3,920.—Converting Iron into Steel.—Thomas J. Barron, New York City.—Patent No. 60,823, dated Jan. 1, 1867.

NEW PUBLICATIONS.

The Transactions of the American Institute for 1868–69 is now ready for distribution. In addition to the usual official reports, it contains the proceedings of the three scientific societies connected with the Institute—the Farmers' Club, the Polytechnic Section, and the Photographical Society. The volume is well edited, and an important feature of it is the admirable summary of scientific news which it contains. This has been prepared from the principal sources of such intelligence, both foreign and domestic.

The American Journal of Science for March contains the following articles of special interest to chemical readers :—

1. "Photometric Experiments," by Ogden N. Rood.
2. "Contributions to the Chemistry of Copper," by T. Sterry Hunt.
3. "On the Silver Mines of Santa Eulalia, State of Chihuahua, Mexico," by James P. Kimball.
4. "Machinery and Processes of the Industrial Arts, and Apparatus of the Exact Sciences." by Frederick A. P. Bernard,
5. "On Norite and Labradorite Rock," by T. Sterry Hunt.
6. "On the Cause of the Color of the Water of Lake Leman, Geneva," by Aug. A. Hayes.
7. "On the Potassic-Cobaltic Nitrite known as Fischer's Salt, and some Analogous and Related Compounds," by Samuel P. Sadtler, contribution from the Laboratory of the Lawrence Scientific School.

The Arts : a new monthly journal of 24 folio pages, devoted to science and arts. Published at Chicago, under the editorship of Joseph M. Hirsh. The first number, for March, 1870, is well printed, and contains some very good articles.

The Metrical Pocket-Book ; or, Manual of Weights, Measures, and Coins. By H. Dalmon. Philadelphia : J. B. Lippincott & Co. 12mo, 54 pp.

A very convenient collection of tables for the conversion of weights, measures, and coins from the English to the metrical system, and *vice versâ ;* with full explanations for their use. It also contains a list of the more important weights, measures, and coins of several other countries.

Catalogue of the Officers and Students of the School of Mines, Columbia College.

This department of Columbia College was organized in 1864 and will complete its sixth year in June.

The Faculty includes a president, eight professors, two instructors in modern languages, nine assistants in chemistry, mineralogy, geology, drawing, &c., besides the librarian.

It has already thirty-seven graduates, the majority of whom have secured positions. The students in attendance number seventy-nine.

There are five courses of instruction:—

1. Civil Engineering.
2. Mining Engineering.
3. Metallurgy.
4. Geology and Natural History.
5. Analytical and Applied Chemistry.

The School is well supplied with all the conveniences for instruction : cabinets of minerals, rocks, fossils, specimens illustrating applied chemistry, models of furnaces, machines, descriptive geometry, constructions, laboratories for qualitative and quantitative analysis, assaying, gas-testing, special investigations, etc.

The library already numbers nearly three thousand volumes, and is specially rich in complete sets of scientific journals, as *Dingler's Polytechnic Journal, Annales de Chimie et de Physique, Grün, Gilbert, and Poggendorff's Annalen, Liebig and Wöhler's Annalen, American Journal of Science*, and many others. Eighty of the best American and European periodicals are regularly received.

The course of instruction in the School is eminently practical, as one or two examples will show :—

During the first year qualitative analysis is taught by lectures and blackboard exercises, and the student is required to repeat all the experiments at his table in the laboratory. Having acquired a thorough experimental knowledge of the reactions of a group of bases or acids, single members of the group or mixtures are submitted to him for identification. He thus proceeds from simple to complex cases till he is able to determine the composition of the most difficult mixtures. Constant use is made of the spectroscope in these investigations.

When the student shows on written and experimental examination that he is sufficiently familiar with qualitative analysis he is allowed to enter the quantitative laboratory.

During the second and third years quantitative analysis is taught by lectures and blackboard exercises, and the student is required to execute in the laboratory in a satisfactory manner a certain number of analyses. He first analyzes substances of known composition, such as crystallized salts, that the accuracy of his work may be tested by a comparison of his results with the true percentages.

These analyses are repeated till he has acquired sufficient skill to insure accurate results. He is then required to make analyses of more complex substances, such as coals, limestones, ores of copper, iron, zinc, and nickel, pig-iron, slags, technical products, etc., cases in which the accuracy of the work is determined by duplicating the analyses, and by comparing the results of different analysts.

Volumetric methods are employed whenever they are more accurate or more expeditious than the gravimetric methods. In this way each student acquires practical experience in the chemical analysis of the ores and products which he is most likely to meet in practice.

During the third year the student is admitted to the assay laboratory, where he is provided with a suitable table and a set of assay apparatus; and where he has access to crucible and muffle furnaces, and to volumetric apparatus for bullion assay by the wet process. The general principles as well as the special methods of assaying are explained in the lecture-room, and at the same time the ores of the various metals are exhibited and described. The student is then supplied with suitable material, ores of known composition, and is required to make assays himself. He first receives ores of lead,—the sulphuret, carbonate, and phosphate,—which he mixes with the proper fluxes, and heats in the furnace, obtaining a button of lead which he carefully weighs, thus determining the percentage of metal in the ore. He then determines by cupellation the amount of silver in the lead. Silver ores are next given to him—at first those which are most easily assayed, such as the mixtures of chloride of silver with quartz; afterwards more complex ores, such as galena, ruby silver ore, mispickel, fahlerz, etc ; these he is required to assay both in the crucible and in the scorifier.

Ores of gold are next supplied,—auriferous quartz, slates, pyrites, blende, etc.,—which are assayed by the most reliable methods.

To facilitate the assay of ores of the precious metals, a system of weights has been introduced, by which the weight of the silver or gold globule obtained in the assay shows at once, without calculation, the number of troy ounces in a ton of ore.* The student then passes on to the assay of silver and gold bullion, the former by Gay-Lussac's volumetric method, the latter by "quartation" or "parting."

Ores of tin, antimony, and iron are then assayed by the dry methods, when the course is completed. Each student thus executes two or three hundred assays himself, under the immediate supervision of the instructor.

Efforts are now being made to combine the School of Mines with the Cooper Institute, which was founded by Peter Cooper for the free education of the working classes in science and art. Such a combination would be of great advantage to both institutions : to the Cooper Institute, in adding to its effective corps of instructors the professors of the School of Mines, and thereby giving to it a higher tone and a larger force ; to the School of Mines, in bringing it at once in immediate contact and sympathy with the public, and in securing for it the active interest of those who have made the Cooper Institute such a marked success.

It is not generally known that Columbia College never closes her doors to those who cannot afford to pay the fees. The trustees some years since very liberally resolved "that the President and Treasurer be authorized to remit the fees of any meritorious young man who cannot afford to pay them." No pledges are exacted, and no distinctions are made—in fact, no one knows who the young men are who have been admitted under this resolution.

We wish this young school of practical science the fullest measure of

* Described in the Chemical News, Am. Repr., vol. v., August, 1869, page 113.

success, and believe that it is destined to exert an important influence on the progress of the arts and sciences in this country. It needs, however, all the encouragement New York can give it. Columbia College cannot afford it one-fourth the money necessary to make it what it should be. New York should be the great school for practical science; all that is now required is money. The School of Mines with the Cooper Institute would constitute a grand nucleus; but at least one million dollars additional endowment would be required to make it what it should be. Is there no one of our great capitalists who will come forward and furnish the funds for this grand project?

BREVITIES.

The Lyceum of Natural History of New York.—At the meeting of the Chemical Section of the Lyceum, April 18th, President Newberry in the chair, Mr. O. Loew presented a paper on hydrogen amalgam. The author discovered accidentally that a zinc amalgam left to itself for some time had been partially converted into a spongy mass, which upon investigation proved to be mercury in combination with hydrogen. The compound, however, was of a very unstable nature; but, after many experiments, an amalgam was obtained which presented the semi-solid, spongy appearance of the amalgams. A zinc amalgam, containing about three per cent. of zinc, was vigorously shaken in a small flask with a considerable amount of a concentrated solution of bichloride of platinum. The mass became hot and dark with precipitated platinum. When it was thrown into water and concentrated hydrochloric acid added, a lively evolution of hydrogen ensued, and a bright mass remained which continued to slowly evolve hydrogen. No analysis of this substance was made. The volume of gas evolved amounted to 160 times the volume of the mercury.

Following the reading of this paper, Dr. I. Walz gave his views upon the non-existence of antozone, and Dr. Paul Schweitzer read notices of recent chemical investigations gathered from foreign journals.

Explosion of Phosphorus.—Early on Saturday morning, Feb. 12th, an explosion occurred in the chemical works of Chas. Pfizer and Co. in Brooklyn. One workman was very seriously, another slightly injured, while the damage to the building was considerable. The exact cause of the explosion has not been made public, though it is known to have been caused in some way by phosphorus. The *World* says: "This is the third explosion that has occurred in Brooklyn within a short time, *exclusive of Kerosene-oil explosions, which are of almost daily occurrence.*"

An Agricultural College in Virginia.—Mr. S. Miller, of Lynchburg, Va., has given $100,000 to found an agricultural college. What a pity it is that those who give generously to the cause of education do not know that we have already five times as many Colleges as the population of the country demands, and that $1,000,000 is the smallest sum that it would be expedient to *begin* a new college with. If Mr. Miller had given his $100,000 to some college already established, and by so doing had enabled it to expand by adding something to its scientific departments, he would have done more for the country and the cause of agricultural education than if he had given three times the sum to found a new college. President Barnard, in a recent report to the Trustees of Columbia College, has shown that the two hundred and twenty colleges in the United States have an average attendance of only eighty students each. As the successful colleges have from one to five hundred students each, the others cannot average forty. We want fewer colleges and larger endowments.

Annual Testing of the National Coinage.—Prof. Joseph Henry, of the Smithsonian Institution, and Prof. Thomas Egleston, Jr., of the School of Mines of Columbia College, have been appointed commissioners for the annual trial of the coin of the United States at the Mint in Philadelphia.

Nitroglycerine Explosions.—On March 2d, shortly before noon, a terrible explosion of nitroglycerine occurred on the new Fleetwood race-course at Morrisania. A blast had been inserted in a large rock the day before, but for some unknown reason failed to explode. One of the men, though cautioned to be careful, began striking the rock with his hammer. He did so but a few times when a terrific explosion took place. Immense fragments of rock were thrown to a great height by the force of the explosion, and on the subsiding of the dust and smoke the bodies of eleven men—one dead, and the rest badly injured—were lying around.

On March 17th, Shaffner's nitroglycerine factory on the Hackensack river, in New Jersey, was destroyed by an explosion. Workmen were engaged in carrying bags of nitroglycerine to a sloop lying near by, when one of them fell from the shoulder of one of the men and exploded. This explosion was immediately followed by another, far more terrific, of the nitroglycerine stored in the building. The factory was entirely demolished, four men were killed outright, fragments of their bodies being scattered in every direction. Several other persons were severely injured. The explosion was heard for miles around, and its force broke the windows of houses a mile distant upon the neighboring hills. At the time of the accident there were 7,000 pounds of nitroglycerine in the building. The value of the property destroyed exceeds $75.000. An act had been passed but a few days before, by the New Jersey Legislature, ordering the removal of the manufactory.

Discovery of Salt.—An exchange announces the discovery of salt-fields, as rich in brine as those recently discovered in Goderich, Canada. They are in Sanilac county, Michigan. The lands comprise about three hundred acres, and lie about six miles in and from Lexington, the county seat of Sanilac.

The Lyceum of Natural History.—At the Meeting of the Chemical Section, held March 14th, the following papers were read:—

Dr. Paul Schweitzer. "Notices of Recent Investigations."
O. Loew. "On the Urine of the Epileptic Spasm."
Dr. H. C. Bolton. "On Di-Nitronaphthalic Acid."
Prof. H. Wurtz. "On Natural Gases of the Palæozoic Rocks.

At the meeting held April 11th, O. Loew, "On Hydrogenium Amalgam;" Dr. Paul Schweitzer, "Notices of Recent Chemical Investigations."

New Copper Process.—The reduction of copper from such of its ores as are in the state of an oxide or semi-compound thereof, such as oxychloride or carbonate of copper, can, it is asserted, be effected by a process recently invented by Professor T. Sterry Hunt, of Canada. The method consists, first, in the use of a solution of neutral protochloride of iron, or of mixtures containing it, for the purpose of converting the oxide or suboxide of copper, or their compounds, into chlorides of copper. Second, in the use of sulphurous acid for the purpose of decomposing the oxychloride of iron formed in the preceding reaction. Third, in the use of a process for the purpose of extracting copper from its naturally or artificially oxidized compounds by the aid of the first, or the first and second of the above-mentioned reactions.—*Am. Journ. Science*, March.

Russian Minerals.—The Russian Government has recently contributed to the Cabinets of the School of Mines of Columbia College a very choice collection of Russian minerals. Among the more striking specimens are nuggets of native gold, native Platinum, Iridosmine, large Emeralds from the Urals, single and in clusters in the gangue, Topaz, Ouwarovite (chrome garnet), Perofskite, Æschynite, Amazon stone, Hessite, Sarmaskite, Alexandrite, and beautiful Malachites, etc. —in all 456 specimens.

Dangerous Kerosene.—The Ohio Legislature has just enacted a very stringent law against the sale of dangerous kerosene. The standard is fixed at 110° F. for the flashing test, and the sale of an oil which flashes below this temperature is severely punished. In case a death results from oil flashing below 110° F., the seller is to be punished for manslaughter.

Lake Superior Copper Mines.—The Calumet and Hecla mines are said to have furnished nearly half the copper produced in the Lake Superior District in 1869.

The Oxy-Hydrogen Blowpipe is to be the burglar's tool of the future, with which the lock of the strongest safe can be fused out in a few minutes, the gases being conveniently transported in the compressed state in iron cylinders.

Grape Sugar.—Factories have recently been established in New York, Brooklyn, and Buffalo, for the manufacture of grape sugar from corn. The starch is extracted from the corn and changed to grape sugar by the action of sulphuric acid. The acid is neutralized with carbonate of lime, and the filtered solution is concentrated in a vacuum pan. In France bone-black is used for decolorizing. The sugar is chiefly used by brewers as a cheap substitute for a portion of the malt. It is also used for the manufacture of vinegar, the chief advantage in this case arising from the fact that the revenue tax on alcohol, the material formerly employed, is avoided.

NOTES AND QUERIES.

Polishing Braid.—Will some reader of the Chemical News inform me how the English and German manufacturers produce the fine polish on their braids?—*C. O. T.*

Electrical Heating Apparatus.—It has been several times stated that the Hôtel Dieu Hospital in Paris is successfully warmed by an electrical heating apparatus. Can any reader give a description of the apparatus employed, or refer me to a journal in which it is described? —*R. S. P.*

Bromine and Iodine.—Can any one give me any information with regard to the manufacture of bromine and iodine in the United States? —*Manufacturer.*

Bartlett's White Lead.—Is this pigment different from ordinary white lead, and is it, as some claim, a new article?—*Painter.*

Dental Vulcanite and Iodized Rubber.—Will some one tell me the difference, if there is any, between these two preparations?—*T. M. B.*

The Monnier Process for Copper and other Ores.—Where can I find it described?—*Smelter.*

THE

CHEMICAL NEWS

AND

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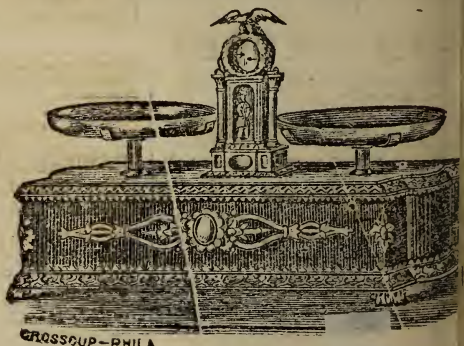

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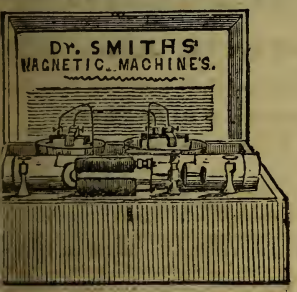

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THE CHEMICAL NEWS.
Vol. VI. No. 6. American Reprint.

CONCERNING

ATOM-FIXING AND ATOM-DISPLACING POWERS.*

BY WALTER NOEL HARTLEY, F.C.S.

Part II.

It is very evident that the secondary atom-fixing powers of nitrogen enter into combination more frequently—that is to say, they are more powerful than the extraordinary atom-fixing powers of chlorine, bromine, and iodine; and as the secondary powers in the nitrogen are those which give trivalent functions to cyanogen, we see why the number and variety of the double cyanides is so extensive—in other words, why cyanogen is more eminently trivalent than the radicles with which it is classed.

Polymerism is the most remarkable feature of cyanogen compounds; the most notable case is that of the three chlorides of cyanogen. Although the existence of the second is somewhat doubtful, still there is a possibility of such a body being obtained.

$$CyCl, \quad Cy_2Cl_2, \quad Cy_3Cl_3.$$

There are at least two ways in which the formulæ for these combinations may be expressed, *e.g.*, either—

I. $'''Cy—Cl'''$

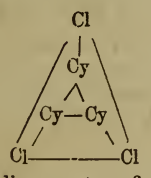
II.
$$Cy—Cl$$
$$\|$$
$$Cy—Cl$$

III.
$$\begin{array}{c} Cl \\ | \\ Cy \\ \wedge \\ Cl—Cy—Cy—Cl \end{array}$$

or—

$Cy'''\equiv Cl'''$

$$Cy—Cl$$
$$\| \ \|$$
$$Cy—Cl$$



In the one case, we have only the ordinary atom-fixing powers of the Cl exerted; but, in the second example, the chlorines are combined with each other by virtue of their triad functions.

Here follow a few cyanogen combinations, formulated in consideration of the triadic character of cyanogen.

Simple cyanides showing their power of combining with other cyanides—

$$CN—M$$
$$\|$$
$$M—CN$$

Ferrocyanides—

$$Fe''.(Cy_6)^{VI}.M_4.$$

According to the general formula before mentioned, relating to the combination of multivalent radicles to form a multivalent molecule—

$$6(Cy''')=(Cy_6)^{VI}$$

Ferricyanides....$(Fe''_2).(Cy_{12})^{IV}.M_6^{X}$.

Cyanic acid.....$(Cy)(HO)$.

This body admits of polymerism, for the HO here functions in place of Cl in the primary cyanogen chloride; we may accordingly look for the hydroxyl analogue of Cy_3Cl_3: this we find in cyanuric acid—

$$(Cy_3)'''(HO)_3.$$

Amides—

Cyanamide.....$Cy'''(H_2N)'''$.

The tertiary amide is melamine, $(Cy_3)'''(H_2N)_3$.

Tricyanamide, $(Cy_2N)'''.(CN)'''$, which may be regarded as $(H_2N)(CN)$, in which Cy_2 replaces H_2, or as NCl_3, in which Cy acts in place of Cl, is an unknown substance, and it is scarcely likely that it exists, considering the instability of the chlorides and iodides of nitrogen, to which it would correspond. The cyanide of ammonium is a body of much less stability than the iodide; tricyanamide may, therefore, be expected to be still more changeable than even chloride or iodide of nitrogen. A class of interesting and complicated ammonia compounds are the cobaltamines, such as, for instance—

Purpuro-cobaltic chloride.....$10H_3N.CoCl_6$.

Luteo-cobaltic chloride .....$12H_3N.CoCl_6$.

These have already been considered by Odling*, who offers a theory of their constitution. Taking CH_2'' as the analogue of NH_3'', the various multiples of ammonia in these complicated molecules are regarded as resembling the multiples of CH_2 in the alcohol radicles; if, then, chloride of ethyl be written—

$$\begin{array}{l} H—CH_2 \\ \quad | \\ Cl—CH_2 \end{array}$$

ammonic chloride of silver may be expressed thus:—

$$\begin{array}{l} Cl—NH_3 \\ \quad | \\ Ag—NH_3 \end{array}$$

Such is the briefest way of stating these views: an extension of them explains more complex ammoniated molecules.

There exists a very large class of substances concerning the nature of which nothing definite in the way of explanation has been offered—I mean the crystalline hydrates.

In classing hydrogen with those metals and other elements having a somewhat marked triadic character, it cannot be made an exception to the law which regulates them; therefore, if the law of Canizzaro and regular atomic displacing power are bases of any value for the classification of bodies, I am of opinion that hydrogen has the same atom-fixing power as chlorine and iodine, &c. Let us regard hydrogen as H'''; then hydroxyl, which, we find, functions as Cl'' or $(H_2N)''$, will assume the quantivalence represented by $(HO)''''$. The combinations of these radicles with hydrogen then produce—

$$(HCl)'' \ (H.H_2N)'' \ (H.HO)''.$$

Observe the case of the bivalent carbon compound, $(CH_2)''$; this undergoes repeated condensations, to form more complex molecules which still remain bivalent. Again, $(H_3N)''$ behaves in a strictly similar manner; and this, too, we find to be precisely the case with water. Thus, by polymerism we may obtain—

$$xH_2O=(xH_2O)'' \text{ or } '';$$

that is to say, any number of molecules of water may be combined to form a molecule with a full combining

* On page 109 (*Am. Repr.*, *May*, '70, *page* 249), the line referring to the doubtful $NO''Cl_3$ and the non-existent $PO''Cl_2$ was, in my rough notes, cut out by a pencil-stroke, but, being inadvertently copied, passed into print.

* *Philosophical Magazine*, December, 1869.

[English Edition, Vol. XXI., No. 540, page 145.]

power equal to 2. It follows, naturally, that we may have sodium carbonate crystallising with 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 molecules of water. We have three parallels in the hydrocarbons, the ammoniated salts and the hydrates—

CH_2''	NH_3''	OH_2''
C_2H_4''	N_2H_6''	O_2H_4''
C_3H_6''	N_3H_9''	O_3H_6''
	&c.	

$$\begin{array}{lll} H.CH_2 & Ag.NH_3 & Na_2O.H_2O \\ | & | & | \\ Cl.CH_2 & Cl.NH_3 & CO_2.H_2O \end{array}$$

The various sodium carbonates may thus be generally expressed, x being equal to any whole number not exceeding 10:—

$$(Na'''_2CO_3)''.(XH_2O)''.$$

Sodium borate.....$(NaHBrO_4)''.(H_{18}O_9)''$.
Magnesium sulphate.....$(MgSO_4)''(H_{12}O_6)''$
Crystalline chlorine hydrate..... $(Cl_2)''(H_{20}O_{10})''$.

Now there is a further resemblance between ammonia and water, than that of condensing to form complex molecules—the one may be su stituted for the other; not a better illustration of this displacement of NH_3 by H_2O can be brought forward than the equations expressing the passage of melamine into cyanuric acid—

$$\underbrace{*C_3H_6N_6}_{\text{Melamine.}}+H_2O-NH_3=\underbrace{C_3N_5H_5O.}_{\text{Ammeline.}}$$

$$\underbrace{2C_3N_5H_5O}_{\text{Ammeline.}}+H_2O-NH_3=\underbrace{C_6N_9H_9O_3.}_{\text{Ammelide.}}$$

$$\underbrace{C_6N_9H_9O_3}_{\text{Ammelide.}}+H_2O-NH_3=\underbrace{2C_3N_4H_4O_2.}_{\text{Melanuric acid.}}$$

$$\underbrace{C_3N_4H_4O_2}_{\text{Melanuric acid.}}+H_2O-NH_3=\underbrace{C_3N_3H_3O_3.}_{\text{Cyanuric acid.}}$$

Perhaps the more exact statement would be to say that hydroxyl displaced amidogen, which, however, comes to the same thing—

$$\underbrace{C_3H_6N_6}_{\text{Melamine.}}+HO-H_2N=\underbrace{C_3N_5H_5O.}_{\text{Ammeline.}}$$

Anhydrous chloride of magnesium is very difficult to obtain, on account of its very greedy absorption of water. This water cannot be driven off by heat; the action of heat expels HCl and leaves MgO. The reason of this is quite obvious, if we suppose the hydrogen of the water, and the chlorine of the magnesium chloride, to be triadic, for in that case they can combine with each other; and the hydrate of magnesium chloride is then an intelligible compound, giving an intelligible decomposition when heated. For instance—

Magnesium chloride..... $(Mg''Cl_2''')''$.
Hydrate of $MgCl_2$..... $(Mg''Cl_2''')''(H_2O)''$.

$$\begin{array}{l} Mg{=}Cl_2 \\ \quad\| \\ O{=}H_2 \end{array}$$

When heated, $MgO+2HCl$.

The chlorides of the dyad metals generally have a tendency to unite their chlorine to the hydrogen of H_2O; and hence the remarkable avidity with which chloride of zinc and chloride of calcium seize upon water. The chlorides of aluminium and iron have the same property, the former most markedly, and give, more or less completely, the same decomposition when heated; chloride of calcium disengages a portion of its Cl as HCl at a high temperature.

There is, of course, a possibility of other similarly-constituted bodies acting as bivalent radicles, and uniting to form a molecule without alteration of combining power; thus, chloride of sodium or potassium may play the same part as HCl in sal ammoniac and NH_3 in ammoniated compounds. We do, indeed, possess substances in which KCl and NaCl have this *rôle* allotted them; for instance, there exist the following analogous substances:—

$$\underbrace{(Co_2Cl_6'').(H_{30}N_{10})''.}_{\text{Purpuro-cobaltic chloride.}} \qquad \underbrace{(Ro_2Cl_6)''.(H_{30}N_{10})''.}_{\text{Rhodammonic chloride.}}$$

$$\underbrace{(Ro_2Cl_6)''.(Na_6Cl_6)''.}_{\text{Sodium rhodous chloride.}} \qquad \underbrace{(Ro_2Cl_6)''.\left(\begin{array}{l} K_6Cl_6 \\ | \\ H_{12}O_6 \end{array}\right)''}_{\text{Rhodous potassium hydrated chloride.}}$$

We have a further example of water, ammonia, and hydrochloric acid, all in the same molecule, united to Ro_2Cl_6, *e.g.*—

$$(Ro_2Cl_6)''.\left[\begin{array}{l} H_{18}N_6 \\ | \\ H_6Cl_6 \\ | \\ H_6O_3 \end{array}\right]''$$

Similar iridium compounds exist, for instance—

$$(Ir_2Cl_6)''.\left(\begin{array}{l} Na_6Cl_6 \\ | \\ H_{48}O_{24} \end{array}\right)'' \qquad (Ir_2Cl_6)''.\left(\begin{array}{l} K_6Cl_6 \\ | \\ H_{12}O_6 \end{array}\right)''$$

$$(Ir_2Cl)_6''.\left[\begin{array}{l} H_{18}N_3 \\ | \\ H_6Cl_6 \\ | \\ H_{12}O_6 \end{array}\right]'' \qquad (Ir_2Cl_6)''.(H_{30}N_{10})''.$$

All these bodies, then, have the radicles, H_3N, H_2O, HCl, KCl, and NaCl condensed in the same manner as CH_2 in the olefines, or alcohol radicles, &c. Certain cyanogen compounds have a similar construction; for example, the ferrocyanides and ferricyanides may, perhaps, be thus represented—

$$(Fe''Cy_2)''.\left[\begin{array}{l} CyM \\ | \\ CyM \\ | \\ CyM \\ | \\ CyM \end{array}\right]'' \qquad \left[\begin{array}{l} Fe''Cy_2 \\ | \\ Fe''Cy_2 \end{array}\right]''.\left[\begin{array}{l} CyM \\ | \\ CyM \\ | \\ CyM \\ Cy{=}Cy \\ MCy \\ | \\ MCy \\ | \\ MCy \end{array}\right]''$$

Ferrocyanides. Ferricyanides.

I consider that such molecular condensations are not confined to compound bodies; the dyad elements, for instance, in potassium-pentasulphide and iodic and periodic anhydrides have a like behaviour, thus:—

$$(S—S—S—S—S)''.(K_2)''$$
$$(O—O—O—O—O).(I_2)''$$

The triads, likewise, as exemplified in the methylium periodides—

$$I_2'''=(I_2)''\left[\begin{array}{l} Me_3N \\ | \\ MeI \end{array}\right]''.\left[\begin{array}{l} I_2 \\ | \\ I_3 \end{array}\right]''$$

From the consideration of these complex combinations, I am led to classify the monad radicles in the following manner:—

* Kekulé. ("Lehrbuch der Organischen Chemie," vol. i., p. 359.)

With powers I. and III.—

Metals { H, K, Na, Tl, Au, Ag } Halogens { Cl, Br, I } Compound radicles { H_2N, CN, HO }

These bodies having monad and triad characters, resemble, as a class, nitrogen and its cogeners, insomuch as they have two weaker atom-fixing powers.

It may be objected from what I have said concerning the triad nature of hydrogen, that we should expect ammonia to be a saturated molecule, and also that the ammonium-oxygen salts should undergo a similar decomposition to that of the haloid salts; for instance, taking ammonium sulphate, it might be supposed that the two free powers of the hydrogens in H_2SO_4 saturate the two free powers of the nitrogens in the ammonia molecules.

$$\left.\begin{matrix} SO_2'' \\ H'''H''' \end{matrix}\right\} O_2 \qquad N\begin{pmatrix} H \\ H \\ H \end{pmatrix}'' \quad N\begin{pmatrix} H \\ H \\ H \end{pmatrix}''$$

This is, however, not the case; as then we should have five hydrogen atoms united to each nitrogen, a combination which has not yet been effected; and, furthermore, we should be assigning to hydrogen the same intensity of atom-fixing power as Cl, Br, and I. We should thus be overlooking the fact that, in the nitrogen series, those elements with the higher atomic weights are those more powerfully pentadic. (It is true that we have no pentachloride of arsenic or bismuth; but this goes for little against the other evidence of pentad character, when we consider that no terhydride of bismuth exists, yet we have a terethide.) The power of fixing five atoms increases with the atomic weight. In the hydrogen family the same thing is obvious; Au, Tl, and I are more powerfully triadic—they, too, are the elements with the higher atomic weights; consequently we should look for a less-markedly triadic character the lower the atomic weight; much less, therefore, should we expect an element with the lowest atomic weight to have so decided a power of fixing three atoms. The reason why we have not a tertiary hydrocyanic acid is on account of the comparatively feeble atom-fixing powers of hydrogen; but we have a compound tending in that direction. Thus, by passing chlorine into HCN, Wurtz obtained this substance—

$$\begin{pmatrix} CyCl \\ CyCl \\ CyH \end{pmatrix}$$

or cyanogen trichloride with one Cl replaced by H.

That the atom-fixing powers of hydrogen are feeble, in comparison with those of chlorine and iodine, is shown by the extreme facility with which the carbonate of sodium, $Na_2Co_3.10H_2O$, under very trifling changes of temperature, and other causes, loses one or more of its molecules of water.

Again, it may be objected that, if H has a triad power, it is less likely to combine with itself than with any other element. I would, to this, answer, no; it appears to me, on the contrary, the extraordinary atom-fixing powers are the true cause of the polymerisation of N, Cy, Cl, I, and H_2O; *e.g.*—

$(Co_2Cl_6).(H_{10}N_{10})$ Cy_3Cl_3N { Me_4, I_5 } $Na_2CO_3.10H_2O$, &c.

In Watts's "Dictionary," it is stated that Kekulé has treated of many of the substances I have mentioned as molecular compounds, combinations resembling the crystalline hydrates. No definition of the constitution of these bodies is given; but we are told they arise from a juxtaposition of molecules. I will quote, however, a statement from one of Kekulé's publications (*Ann. der Chem. und Pharm.*, vol. civ., p. 133)—"A combination of several molecules belonging to the types, HClHCl, H_2OH_2O, $HClH_2O$, can only take place if, by the entrance of a polyatomic radicle in the place of two or three atoms of hydrogen, a cause of union occurs." This amounts to saying that the crystalline hydrates are not combinations. Now this juxtaposition of molecules must be either a combination of molecules or not; if it be not a combination of molecules, then the resulting body is not a chemical compound, but is such a juxtaposition of molecules as we generally understand by a mixture of liquids or gases bearing no hitherto recognised relation to the atomic weights. On the other hand, if it be a combination of molecules, it is evident the molecules are not previously-saturated compounds, otherwise they would have no combining power, and consequently would not combine; for the combining power of a molecule is dependent on the non-saturated condition of one or more of its constituent atoms. Regarding a combination of SO_3 and KCl, Williamson* makes a similar statement, to the effect that neither the chlorine nor potassium are other than monad elements—they are combined to saturation; yet the two molecules, SO_3 and KCl, are held together by chemical force. Are we to have two kinds of chemical force, one holding together K and Cl, the other uniting So_3 and KCl, or is it only a matter of degree of force exerted, which makes one class of compounds differ from another? I have endeavoured to show that the latter alternative is what I am induced to believe correct.

Somewhat in accordance with what is suggested in this paper are the results communicated to the Chemical Society by Dr. Gladstone, "On Refraction Equivalents."† Some of the elements have a double refraction value, "and this peculiarity is, in most cases, coincident with a change of atomicity. Thus iron, in the ferrous salts, has the equivalent 12·0, in the ferric salt, 20·1; and, since the refraction equivalent of iron in potassic ferridcyanide is 11·7, the view suggests itself that the metal is here in the same condition as in the ferrous salts."

My formula given above for ferricyanides is in harmony with this. But amongst those elements with a double value, we find Cl, Br, I, and H; it is not improbable that behind this is lurking the evidence of the truth of my suggestions regarding monad elements. Furthermore, Dr. Gladstone mentioned that NH_4Cl gave numbers equivalent to NH_3 and HCl, which is to be expected if the true constitution be $NH_3''.HCl''$, but not otherwise. The same results may be looked for with $PCl_3.Cl_2$ and $SbCl_3.Cl_2$; for it stands to reason that these bodies do not demonstrate the usual decomposition of chlorides by heat, else we should have the following equation verified:—

$$2CHCl_3 = C_2Cl_4 + 2HCl,$$

a change which the author at one time thought possible, and vainly endeavoured, after repeated trials, to effect. What really takes place is thus represented:—

$$6CHCl_3 = C_6Cl_6 + 6HCl + 6Cl.$$

I should have preferred to have further developed these

* *Proceedings of the Royal Institution*, vol. iv., p. 277.
† Chemical News, vol. xxi., p. 114 (*Am. Repr.*, *May*, '70, *page* 263).

views, to have sought longer for proofs of their correctness, and placed them in a more carefully-stated form, but I am induced to give them publicity in their crude state, on account of my belief that a tendency of thought towards the same point is rife at the present time in the minds of others. To give an impetus, therefore, to speculation in the same direction, I commit my views to those interested in the subject.

London, March 12th, 1870.

DETERMINATION OF SULPHUR IN IRONS.

BY H. B. HAMILTON,

MILLFIELDS IRON WORKS, STAFFORDSHIRE.

THE following process will, it is believed, be found a convenient modification of that described in Fresenius's "Quantitative Analysis," since it not only dispenses with the trouble of oxidation by fusion, but effects much saving of time. A weighed quantity of iron (for puddle bars not less than 10 grms.) is thrown into a capacious flask, about an ounce of water is added, and the whole agitated to prevent caking in the after process. A cork is inserted into the mouth with two perforations, the one for a thistle funnel with tube and bulb, curved as represented in Fresenius's "Quantitative Analysis," to admit acid; the other for a tube bent at right angles. The latter tube communicates with a U-tube, containing a solution of caustic potash free from sulphate. (I attached another U-tube to the former one, containing a solution of oxide of lead in caustic potash.) Sometimes concentrated hydrochloric acid, and sometimes water, are to be poured in at the funnel, according to circumstances. As soon as the action, after pouring enough hydrochloric acid into the flask, has almost ceased, the contents of the latter are to be boiled. The flame is then taken away, and, as soon as the ebullition has ceased, air is sucked through the apparatus for about a minute. This process may be advantageously repeated, if, as will easily be discovered, the action of the acid has not entirely ceased. (After several experiments the second U-tube did not show the slightest blackening.) The contents of the first U-tube are emptied into a beaker, and the U-tube rinsed out with distilled water. A current of chlorine is allowed for some time to pass through the solution, which is then boiled, acidulated with hydrochloric acid, and boiled again, to drive off all hypochlorous acid, when it is precipitated with chloride of barium.

The contents of the flask are filtered through asbestos, and, without washing the residue at all, it is transferred again to the flask, removing every particle from the funnel by means of a small quantity of nitro-hydrochloric acid. After heating, in order to oxidise the black residue with the nitro-hydrochloric acid, water is to be added, and some carbonate of soda, free from sulphate, to neutralise the large excess of acid. After boiling, filter, taking care that the solution is still slightly acid; precipitate with chloride of barium, add the precipitated solution with precipitate to the former one, and proceed in the usual manner.

It will, perhaps, be interesting to some, if I give results of a few of my analyses according to this method:—

	Per cent of S. 1st anal.	Per cent of S. 2nd anal.	Difference.
Sample No. I.....	0·038	0·026	0·012
" No. II.....	0·088	0·073	0·015
" No. III.....	0·045	0·033	0·012

ON A NEW METHOD OF MANUFACTURING CAUSTIC SODA.

PATENTED BY M. BACHET, OF PARIS.*

BY R. CALVERT CLAPHAM, F.C.S.

EXPERIMENTS were made by Lord Dundonald as far back as 1790—1794 in making caustic soda by the decomposition of common salt with litharge. This process was conducted on a manufacturing scale by the late Mr. W. Losh, in 1799, and I am indebted to him for some details of the process then in operation.

The proportions recommended to produce the best results were 100 parts of salt and 300 parts of oxide of lead; but, when the greatest care was taken, they did not succeed in obtaining more than 3·0 parts of caustic soda; or 5·6 per cent of salt was decomposed. At that time, they had many difficulties to contend with in preventing the loss of lead in the solutions; and they had no plan in operation to re-convert the white lead pigment, which was formed back again into an oxide of lead, ready to receive a fresh charge of salt. They had, therefore, to contend with considerable expenses, and some loss of lead in melting it down again to a metallic state. It was only the high price of soda (which may be calculated as equal to £85 to £90 per ton of 70 per cent caustic soda) which enabled the operations to be conducted at a profit. I shall not trouble the Members with any details of the changes which have taken place in the manufacture of soda from that time to the present. It is sufficient to say that, after three-quarters of a century has passed away, a patent has been taken out by M. Bachet, of Paris, for the production of caustic soda by means of salt and litharge, which, in some respects, resembles the old method, but with this marked difference—that hydrate of lime is added to the mixture, which has the effect of preventing the reactions which take place between the soda and the chloride of lead by the old method, resulting in the re-conversion of the chloride of lead into common salt. And the new process also includes a method of regenerating the white lead pigment, so that it may be used over and over again. The experiments I am about to describe have been conducted by the Walker Alkali Company, at Walker, during the past nine months. Many trials were made as to the best mixtures to be used; but, as far as has yet been ascertained, the following produce good results:—

100 parts of litharge,
70 " salt,
50 " lime.

About 5 cwts. of this mixture is ground on a mill, a small quantity of water being added to dissolve the salt. It forms a white, pulpy mass, which is ready to be drawn off the mill in a quarter of an hour. Indeed, as far as experiment can prove, it appears as if the decomposition was almost instantaneous; and, if the operation is properly conducted, about 19 to 20 per cent of the salt is converted into caustic soda. It will be seen hereafter how the remainder of the salt is treated. The decompositions on the mill appear to be threefold—the production of caustic soda, of chloride of lead, and of hydrate of oxide of lead; a portion of the salt and the litharge remaining unacted upon. The pulpy material drawn from the mill is pumped into a press, which is worked at a pressure of 145 lbs. to the square inch. A clear liquid runs out, consisting of caustic soda and brine, containing a variable quantity

* Read before the Newcastle Chemical Society, March 24th, 1870.

of lead. With the object of separating completely the small quantity of lead from the soda solutions, various plans have been tried.

Sodium sulphide separates the lead easily; but there are some objections to this process.

Carbonate of soda also precipitates it as a carbonate; but, in some cases, for reasons difficult to explain, the action is not certain.

The simplest method which has been pursued is to pass the solution through hydrate of lime in the form of a filter. All the lead is precipitated; and, on testing the filtered solutions, they only give a slight colour when treated with sodium sulphide.

The lime containing the lead is afterwards used on the mill, in the place of fresh lime.

When the liquors are free of lead, they are then evaporated in an iron pan, like an ordinary salt-pan; and the salt which deposits at the bottom is gradually fished out, and may be again used, with fresh oxide of lead, on the mill.

But the process may be varied, so as to produce a much larger decomposition of the salt, by running the liquors from the press back again on to the mill, and adding thereto fresh charges of litharge and lime.

In this way, 47 to 50 per cent of the salt may be decomposed and converted into caustic soda; and a much stronger soda liquor is obtained to evaporate in the pans, a considerable amount of labour and cost of coals being saved. In either case, the solutions are concentrated till they are ready to be run into a caustic pot, where they are finished in the usual way, producing, with ordinary care, a caustic soda of 70 per cent.

We have now finished with the solutions, and must return to the dry white-lead cakes left in the press before described, the treatment of which forms one of the most important features in the patent.

When freed from its soda solutions it consists of—

Chloride of lead,
Hydrate of lead,
Litharge unacted upon,
Lime unacted upon.

As hydrate of lead has no action in decomposing salt, it becomes not only a question of how to decompose the chloride of lead, but also how to convert the hydrate into an oxide which will again act upon salt. The method which appears most likely to effect these ends is, in the first instance, to dry the material from the press, at a temperature of about 350°F. It turns to a fine orange-yellow colour, and the hydrate is decomposed and is converted into a heavy oxide.

The mass is then slowly thrown into a boiling solution of lime-water, in which the chloride of lead is decomposed, forming chloride of calcium and oxide of lead. This solution is now run off, and after one or two washings in fresh lime-water, the lead is again fit to be used at the mill. The liquors which are run off, however, are not be to thrown away, as they contain lead in solution, and it is necessary to separate it to prevent loss.

This is not a difficult operation, as in the cooling of the hot liquors the lead nearly all deposits in fine long crystals, and the remainder left in the solution is precipitated by means of common salt or hydrochloric acid, so that a mere trace remains on testing with sodium sulphide; the chloride of lead thus obtained is decomposed with lime-water as just described, and the oxide applied to the mill. From this it appears that, with ordinary care, all the lead may be recovered, but it is only fair to allow that, in conducting a large manufactory, a portion will be lost, which requires to be estimated for in the cost of production.

Thus far the process appears to work quite smoothly, but the regenerated lead obtained as above described does not in all cases act the same. Sometimes its action is quite as energetic on salt as the original litharge, but in other cases it has proved less satisfactory when worked frequently over again in the process. The cause of this change is not always sufficiently clear; in some instances, during the heating of the material, Pb 3·04 and Pb 0·2, are formed, both of which, I find, have no action on salt. Another difficulty has been in the rapid absorption of carbonic acid by both the hydrates of lime and of lead, resulting in a product which has not only no action on salt, but appears, to a large extent, to prevent the free action of the oxide of lead. When, however, the process is conducted quickly, the regenerated oxide of lead may be used over and over again more frequently; but, so far as experiment has proved, it appears likely that, after five or six operations, it will be necessary to calcine a portion of it, and this is proposed to be effected as under. It is mixed with water, and the lighter portion syphoned off, settled, and dried. This portion, which is found to contain nearly all the carbonates, is then calcined at a strong red heat, in a furnace constructed with a working bed of hard mountain limestone, but a roof of ordinary fire bricks. It parts with its carbonic acid quite easily at a red heat, and is then ready to be used in the mill again.

Such is briefly an outline of this patent, and the importance of a new process, with the object of producing caustic soda by more direct means than at present exists, cannot be exaggerated. Without taking into account the total production of soda, but confining the calculation to caustic soda alone, we find that 20,000 tons of this article are now made in England, of the value of £350,000 annually. The plant required is not expensive, consisting chiefly of mills, presses, evaporating pans, and furnaces.

On the whole, there appears a reasonable prospect, when M. Bachet's patent is fully worked out in practice, that caustic soda will be made at a considerable reduction in cost on the present plan. But as there are gentlemen present who understand these subjects in all their bearings so well, I now leave the result of the experiments in their hands, and shall be happy to hear their criticisms.

ON MICROSCOPICAL MANIPULATION.

BY W. T. SUFFOLK, F.R.M.S.

(Continued from Amer. Repr., May, 1870, page 238.)

Lesson V.

The results of aquatic collecting will require a somewhat different treatment from that recommended in the preceding lessons. Owing to the density of the medium in which the objects are viewed, and the generally diaphanous nature of the organisms themselves, comparatively little use can be made of reflected light as a means of illumination; its employment is, therefore, rather the exception than the rule.

An account of the varied modes of collecting objects of this kind and their habitats, would almost occupy a volume. For obtaining fresh-water specimens, advantage may be taken of the excursions of the various

London and provincial societies. The Quekett Microscopical Club arranges a series of excursions, which take place every fortnight during the summer months; and, as experienced naturalists always accompany these expeditions, the student may derive much practical instruction in the way of collecting and identifying specimens. The microscope should always accompany the student to the sea-side during a temporary residence, and it is well, if possible, to take the usual working instrument, well equipped with objectives and apparatus, and not some small contrivance which has nothing to recommend it but portability. The following works also contain useful information on the subject of marine and fresh-water collecting:—"Handy-Book of Algæ, &c.," Rev. W. W. Spicer; "Beale," p. 146; "The Aquarium, Devonshire Coast, Tenby, &c.," P. H. Gosse; "Sea-side Studies," G. H. Lewes; "Marvels of Pond Life," H. J. Slack; "History of Infusoria," A. Prichard. See also list of microscopical works in "Beale," p. 364.

The preliminary examination of a quantity of aquatic material is generally most conveniently done in a large trough (Fig. 15, vol. xx., p. 181; *Am. Repr., Dec.*, '69, *page* 326), with a low power, O_3* and *dark-field illumination*, mirror turned aside, or *long-focus spotted-lens;* the paraboloid has too short a focus for this purpose.

A good diagnosis can often be made by examination in the bottle or tube in which the collection is brought home, with the pocket lens. Many of the larger animals and plants can be distinguished with this low power, and those too small to be distinctly made out can often be identified by a trained eye. Objects in water may be very conveniently examined out of doors with the pocket-lens, if placed between two small pieces of glass (a 3 × 1 slide cut in half, and the sharp edges smoothed with a corundum rubber, answers well): these can be kept in the waistcoat pocket, ready for use.

Portions required for more minute examination, if on plants, may be detached with the scissors or forceps. Free-swimming animals and plants, or deposits, may be taken up with a suitable pipette, by closing the upper end with the finger, and bringing the other extremity over the object to be secured. The finger is then to be removed; and the water rushes in, carrying the object with it. The finger is again applied, to close the top of the tube, which is then lifted out of the water, and the object transferred to a slide-cell or other convenient vessel.

If the object is very thin, a common slide, covered with a piece of thin glass, will serve for the examination with a tolerably high power. Should the object be liable to injury from the pressure of the cover, a cell may be used, or a hair placed between the thin glass and the slide. In all cases in which the object is required to be kept for some days, the growing-slide (Fig. 16, vol. xx., p. 181; *Am. Repr., Dec.*, '69, *page* 326) should be used: some of these may conveniently be made with cells attached. The thin trough (Fig. 14, vol. xx., p. 181; *Am. Repr., Dec.*, '69, *page* 326) may sometimes be useful. All these contrivances permit the employment of the parabaloid for dark-field illumination, and also the achromatic condenser. The live-box supplied with most microscopes is sometimes useful, but has the disadvantage, from the height it raises the object above the stage, of preventing the employment of any sub-stage illuminator but the mirror.

It is frequently necessary to subject the substance under examination to pressure. For this purpose, an instrument known as a compressorium is necessary, two of which, more completely fulfilling the requirements of the microscopist than older contrivances, are the invention of the late Richard Beck (*Quarterly Microscopical Journal*, vol. xii., p. 4); we are also indebted to him for a live-trap for confining small active animals within the field of the microscope, without compressing them or otherwise restraining their movements (*Quarterly Microscopical Journal*, vol. xiii., p. 113).

The habits of marine or fresh-water animals may be watched in aquaria, which need not of necessity be expensive: basins and glass jars answer the purpose extremely well. The Marine Aquarium should always be carefully examined after the introduction of fresh specimens of seaweed, as they usually bring in with them large numbers of minute animals.

The author, instead of throwing away the results of fresh-water collection when done with, places them in a tank in the garden, used for growing aquatic plants, which, although only containing about 200 gallons of water, always yields a rich supply of microscopic objects, most of which regularly breed and appear from year to year.

Lesson VI.

Fibres used in the Manufacture of Clothing, and Analysis of Textile Fabrics.

The materials of textile manufactures may be divided into four classes, two of which are derived from the vegetable and two from the animal kingdom.

The vegetable fibres consist either of hairs or liber cells, a tissue resembling woody fibre.

Of hairs, only those covering the seeds of several species of *Gossypium* (a genus of malvaceous plants) are used in commerce, and are known as *cotton*.

The liber cells are supplied from many sources, and are used for a great variety of purposes, every kind of fabric, from fine linen to cordage, being made from them.

Familiar examples are flax (*Linum usatissimum*), jute (*Corchorus capsularis*), hemp (*Cannabis sativa*), China-grass or rhea (*Bœhmeria nivea*).

The animal materials consist of silk, an albuminous fibre produced by various caterpillars.

The remaining class comprises the hairs of those animals which are capable of being either spun or felted—such as wool and its varieties, as alpaca, &c., hairs of rabbit, beaver, &c.

Specimens Required.—Fibres of cotton, flax, hemp, silk, and wool; pieces of calico, muslin, linen, silk, flannel or blanket, and any other woven fabrics and threads procurable; also hairs of various animals.

Examine fibres of cotton, flax, hemp, silk, and wool, as described in Lessons I. and II., with O1 or O½, on stage-plate, by reflected light.

Notice the differences of structure. *Cotton* consists of *flattened, twisted fibres. Flax* and *hemp* are *rounded*, with more or less apparent *transverse markings. Silk* is conspicuous for the *absence of all structural peculiarities. Wool* exhibits a *circular fibre*, with *delicate markings*.

It will be seen that the four classes of fibres have all well-marked characters, and can be readily distinguished from each other under the microscope.

Mount specimens of all the fibres collected, by dry

* Ross's 4-inch objective is very suitable for this kind of work; it defines well, bears a considerable amount of eye-piece power, will take in an object of about 0·4 inch diameter, and is low in price.

process (vol. xx., p. 193; *Am. Repr., Dec.*, '69, *page* 328), taking care, as fibrous tissues are very hygroscopic, that they are properly dried. As they will bear a heat not exceeding that of boiling water without injury, the ether process will not be required. Label, and preserve for future reference. Place, also, a small portion of the fibres of cotton, flax, and hemp in separate bottles, with saturated solution of chloride of calcium; leave them to soak for a few days, and then mount in same fluid, taking the precaution to separate the fibres by tearing them apart with needles, so that the single fibres may be well displayed before closing the cell. The silk and wool should be mounted dry, and also in balsam, with as little heat as possible, if transparent specimens are required.

As the mountings in chloride of calcium will be some days in hand, unless the air-pump is used, prepare portions of cotton and flax, on slides, with turpentine, which will render the fibres transparent; and examine with a power of not less than O$\frac{1}{4}$ (O$\frac{1}{4}$ will be better), with polarised light, using achromatic condenser and eye-piece analyser (vol. xxi., p. 8; *Am. Repr., March*, '70, *page* 135). If the condenser is not accessible, the intensity of the illumination may be greatly increased by concentrating the light of the lamp on the concave mirror with the condensing-lens.

The *cotton* will display *more or less colour*, indicating doubly-refractive properties, but *no very marked structural peculiarities*. The *flax* will show *a vast amount of structure*. The transverse markings seen by reflected light will become more conspicuous, and other markings of a more or less spiral nature will, with proper adjustment of the selenites (vol. xxi., p. 9; *Am. Repr., Mar.*, '70, *page* 136), be rendered visible. These consist of thickenings of the cell wall, known as secondary deposits, and are easily seen by polarised light, owing to their doubly-refractive power differing from that of the thinner portions of the tissue; while, by ordinary transmitted light, they would have been nearly invisible, owing to their transparency. It is much easier to distinguish the fibres of cotton and flax in a mixed fabric by observations with polarised light than by any other means. A power of O1 is quite sufficient when merely the presence of cotton on flax has to be determined.

A careful series of observations on liber cells is much wanted. At present, it is difficult to distinguish between flax and hemp, and other fibres of the same class, so that they might be detected with certainty in mixed fabrics. The chief impediment consists in the very close resemblance of all these fibres to each other. It is, in general, much easier to distinguish them in mass, by various peculiarities of colour, texture, &c., than by the most careful microscopical examination of single fibres.

The action of dyes might reveal some peculiarities connected with these tissues. Experiments on cotton have been tried by Mr. W. Crum, of Manchester. Transverse sections* have been examined by a Continental observer, and, although somewhat difficult to obtain, might be studied with advantage. The whole subject is much in need of investigation.

Woody fibres are used occasionally for purposes of adulteration; an instance is mentioned under silk. A curious case came under the author's notice, in which cotton wick, intended for the manufacture of composite candles, was adulterated with a small quantity (about 5 per cent.) of some undetermined liber fibre. Trivial as was the amount of this admixture, it entirely unfitted the wick for the purpose for which it was intended, causing it to remain unconsumed, and accumulate, instead of bending over to the outer part of the flame, and burning away.

For account of liber cells, see—Bentley's "Manual of Botany," p. 30; article, *Liber*, "Micrographic Dictionary," p. 417; *Science Gossip*, vol. ii., p. 10.

The length of cotton-fibre (*staple*) is determined by drawing out a tuft of the cotton repeatedly between the fingers, until the hairs are laid parallel, and then measuring the length of the tuft. This is the mode of measurement in use among cotton-brokers. An easy and accurate method of measuring single fibres of cotton had long been a desideratum in analytical operations. In 1862, Captain C. J. Mitchell, of the Government Central Museum, Madras, writes, respecting a process he had used for this purpose:—"It is exceedingly tedious, and very trying to both eyes and head." Shortly afterwards, the author endeavoured to measure single fibres by fixing them with gum upon a glass slide, making a drawing with the camera-lucida, and measuring the curved line so obtained with a map-measurer. The enlarged drawing was from 18 inches to 2 feet in length. The chief objection to this process was the amount of time occupied in the investigation, ordinary micrometrical operations not being applicable, on account of the great length of the fibres and the impossibility of measuring them as straight lines; hence the necessity of making drawings, and following all the curves with the little measuring wheel. A simple and accurate process has been invented by Mr. C. O'Neill, and is described by him in a communication to the Literary and Philosophical Society of Manchester ("Memoirs," 1863—4, p. 389). The apparatus employed consists of a plate of glass, on which is ruled a scale 2 inches long, divided into tenths, a pair of fine forceps, and two camel-hair pencils. The scale is laid upon a piece of black cloth, and well lighted, by daylight or a lamp, with condensing lens. The fibres are selected, and held by the forceps, and, with one of the pencils, moistened in the mouth, pressed and drawn out on the glass plate; the forceps are then dropped, and the other pencil brought into use to lay out the fibre, the length of which is then read off. The operation requires considerable practice, but, when acquired, single fibres can be measured to 0·05 inch with sufficient rapidity for analytical purposes. As some cotton-fibres —such as Sea Island—reach the length of 2 inches, it is well to have the scale extended to 3 inches: this will also prevent the necessity of being careful about placing the fibre on the beginning of the scale, as there will be plenty of space. And it is convenient to have a scale of about the same length divided into millimetres. For comparison with Continental observations, Mr. O'Neill gives the following results of some observations on the length of cotton fibres:—

	Maximum. in.	Mean. in.	Minimum. in.
Sea Island	2·00	1·6800	1·35
Another sample	2·05	1·4440	1·10
Queensland	1·95	1·5010	1·10
Egyptian	1·55	1·2520	0·95
Pernambuco	1·50	1·6750	0·75
Surat	1·15	0·9425	0·75
Another sample	1·10	0·9250	0·55
Another sample	1·05	0·9050	0·70

* Fibres, hairs, and other long thin substances of which sections are required should be made up into bundles with weak glue, and cut into thin slices with a sharp razor; the sections can be liberated by dissolving the gelatine in hot water.

In another communication (1862-3, p. 389), Mr. O'Neill describes an ingenious instrument for measuring the tensile-strength of fibres. The following are some of the mean breaking-weights of single cotton-fibres :—

	grs.
Sea Island	83·9
Another sample	90·0
Surat	105·8
Another sample	141·9
Egyptian	108 0
Another sample	127·0
Pernambuco	140·0

These determinations are of great value to the manufacturer. And those intending to make textile fabrics their study would do well to consult Mr. O'Neill's papers.

The amount of twisting in a thread is a very important element in the estimation of its strength. The famed Dacca muslins owe much of their superiority in lightness * and strength to the tightness of the twist in the delicate filaments of which they are composed. This has been determined by Dr. J. F. Watson, who gives the following as the average number of twists per inch in four samples of muslin:—French, 68·8; English, 56·6; Dacca, 110·1; Dacca (another sample), 80·7. The whole subject is carefully worked out by Dr. Watson in "The Textile Manufactures and Costumes of the People of India," pp. 59—74.

Cotton is mixed with other fibres legitimately in the well-known "union cloth," a compound of flax and cotton, and as an adulteration, with woollen fabrics, and in some specimens of lint.

Silk will be found to burn differently from the fibres of the two classes hitherto considered. It curls up, and ultimately fuses and burns, giving off the disagreeable odour common to animal tissues, as hair, wool, feathers, &c. The fibres depolarise light, giving more or less colour, but do not exhibit any structural peculiarities. Silk is entirely dissolved when boiled in strong solutions of caustic potash or soda. If *cautiously* heated on a slide in a strong solution of soda, the fibres will be found to swell, and bulge out in parts.

Admixtures of other fibres with silk are easily detected, by the appearance of the unravelled threads, under the microscope. The material most commonly used to adulterate silk is jute. The microscopical characters of this fibre are not of a very marked description. It is best distinguished by examining the residue under the microscope after the sample has been boiled in a strong caustic alkaline solution. Specimens of silk, breaking and fraying when pressed into tight folds, may always be suspected of containing jute: the beautiful gloss of this fibre, when carefully prepared, is the reason of its selection as an adulterating material.

Wool.—As already observed, this fibre presents very marked structural peculiarities. In burning, the same phenomena are apparent as in the case of silk; it is also soluble in hot alkaline solutions. The histological nature of the surface-markings may be considered undetermined at present, the apparent imbrications being interpreted by some as scales: and in many hairs (those of some of the bats especially) this character is very marked (M. C. Cooke, *Transactions of the Quekett Microscopical Club*, vol. i., pp. 33 and 55, Plates 1, 2, and 3; article, *Hairs of Animals*, "Micrographic Dictionary," p. 330; "Carpenter," p. 704).

Two valuable communications on "Wool, Commercially and Microscopically Considered" were made by Mr. N. Burgess to the Quekett Microscopical Club. Unfortunately, only abstracts appear in the *Transactions* (vol. i., p. 23). In this paper some important points of microscopical structure, bearing upon the felting process, are noticed. It is shown that the felting qualities of wool depend upon the number of waves or curvatures in the length of a fibre, and not upon the apparent serrations or imbrications.

When heated on a slide with strong solution of soda, wool swells, the medulla or interior cellular portion becomes more distinct, and the imbrications disappear, seeming to have unfolded.

Wool is mixed with other substances in the manufacture of fabrics generally with the view of improving the texture or appearance, and not usually as an adulteration.

ON THE

LIGNITES OF MIDDLE AND SOUTHERN ITALY.*

BY AUGUSTUS A. HAYES, M.D.,

STATE ASSAYER OF MASSACHUSETTS.

Since the independence of the Free States of Italy was achieved, scientific explorations have shown the existence of various and considerable natural resources, which may become of great national importance to that country. Among these are numerous deposits of lignite and bitumens; and even sources of mineral oils have been found.

Professor Carlo Cassola, of Naples, one of the most active scientific men of that country, has influenced the present Government so far that aid in the collection of specimens from various localities has been secured; and the parcels sent to Naples now form a large aggregate in the extensive laboratory and museum in charge of Professor Cassola.

Through the kindness of the Professor, I was allowed to examine and analyse some of these samples; and I also visited one of the deposits, a few miles distant from Benevento, in company with himself, scientific friends, and representatives of the Government.

The lignites are found in a formation which represents the tertiary of this country. Clay, conglomerate, and decomposing schists were the immediate enclosing rocks of this locality, and the beds had evidently been broken up and moved from position of deposition by superficial changes.

Some of the lignites presented the varieties of brown coal, with more or less of woody structure visible, and they differed in power of retaining moisture, in gravity, colour, and compactness. One variety was remarkable, inasmuch as it so closely resembled Cannel coal in appearance and general physical characters as to be easily taken for Cannel. It requires, indeed, careful examination to enable one to distinguish it from Cannel; and, as seen, it promised to prove an excellent fuel.

I engaged in the chemical analysis of the Cannel-like variety with great interest, and soon found it to differ remarkably from ordinary lignite, in containing a large proportion of combined water, which was retained after long exposure to a high temperature; indeed, some

* A piece of fine Dacca muslin, 1 yard wide and 10 yards 12 inches long, weighed only 1565 grains (Dr. Watson; work cited, p. 75).

* From the *American Gas-Light Journal*. Communicated by the Author to the Chemical News.

samples afforded water at 600° F., and the point of complete desiccation did not vary more than 50° F. from the point of temperature necessary to cause decomposition.

An air-dried, selected, average sample of the Cannel-like variety afforded—.

Moisture, as given off at 100° to 110°C.....	3·40
Water, lost in air at 200° to 230° C.....	18 20
Volatile combustible matter.....	29·80
Solid carbon, as compact coke.....	43·60
Greyish-white ash.....	5·00
	100·00

The above composition does not express a valuable fuel; and other samples contain, not only more combined water, but earthy substances also, which would appear as ash in large amount. Indeed the varieties of these minerals found in Southern Italy, when compared with good laminated coal, as fuel or as a source of power, did not warrant the belief that they can replace coal.

This is a subject of vital importance to a nation wishing to maintain steamships upon the ocean, or to carry on those operations in which fuel is an essential element of aid; and every well-wisher of Italy will be interested in the effort now put forth in the search of coal, and in devising substitutes for this mineral suitable for consumption on ship-board. There is much of newly-awakened enterprise and activity of mental ability in free Italy, and the sources of physical well-being and progress were never more carefully scanned in all directions.

In connection with the subject of fuel, it was a happy suggestion of Professor Cassola that led to the mode in which these lignites and hydrous fuels may be burned with advantage. He proposed to mix or saturate the porous lignites with the crude natural bitumens, and burn the nearly-dry artificial mixture thus made as coal, in any ordinary stove or fire-place, on ship-board or in work-shops.

The lignites readily absorbed about 20 per cent. of the semi-fluid hydrocarbon; and the result was not adhesive, and could be quite as comfortably handled as softer varieties of coal. This mixture, by estimation, had a high practical value, and presented the utilisation of crude petroleum as fuel under a new and inviting aspect.

The burning of any kind of fluid hydrocarbon which can be converted into oils as fuel must be regarded always as a misapplication of a valuable natural production. With this conviction, I had witnessed the experiments made on board a gun-boat of our own Navy, where much invention of a high character had solved the problems and overcome the obstacles presented in burning completely. Yet, unless in other applications the crude material has little value, it can never compete with coal economically.

The bitumens of Southern Italy resemble those of California generally, though their petroleum oil has been drawn from tolerably-deep wells; and the latter are, therefore, adapted to this new use, becoming valuable, not as fuel *per se*, but in conferring on a poor hydrous-combustible a greatly-increased power in producing heat.

This suggestion of the Professor at once led to application on a useful scale. The Government placed a steamship in order for comparative trials of the new fuel (that is, average lignite which had absorbed about one-fifth of its weight of dark, semi-fluid bitumen, and become nearly dry), and, on the other hand, the best English steam-coal supplied to the Navy, were used in equal weights in producing steam-power. Engagements prevented me from witnessing the trials; but the Admiral's report, expressing the practical results of propelling the ship from point to point of equal distances, gave for the new fuel a value at least equal to that of the best coal, for naval purposes. The mixed fuel, in the trials, was burned in the ordinary coal-furnaces and did not produce smoke.

This application of Professor Cassola bec great importance, therefore, if subsequent sea show that Italy possesses large deposits of lig bitumens; and this mode of utilising hydrous carries with it those practical features which mend its adoption wherever hydrous fuels an mens can meet as products of small value on the

In California, where semi-fluid bitumens exist, increasing facilities for transportation may allow the value of lignites of that and other states to be greatly increased by the absorption of bitumen, so as to form an artificial fuel in which the combined water of the lignite will be utilised to form a strongly-heating flame in the otherwise smoke-producing vapours of the bitumen.

Boston, Mass., December 29th, 1869.

ON THE

RELATION BETWEEN THE SUN'S ALTITUDE AND THE CHEMICAL INTENSITY OF TOTAL DAYLIGHT IN A CLOUDLESS SKY.*

BY HENRY E. ROSCOE, F.R.S., &C., AND T. E. THORPE, PH.D., &C.

In this communication, the authors give the results of a series of determinations of the chemical intensity of total daylight, made in the autumn of 1867, on the flat plateau of the River Tagus, about 8½ miles S. E. of Lisbon, under a cloudless sky, with the object of ascertaining the relation existing between the solar altitude and the chemical intensity of the light.

The experiments were made as follows:—1. The chemical action of total daylight was observed in the ordinary manner; 2. The chemical action of the diffused daylight was then observed, by throwing on to the exposed paper the shadow of a small, blackened brass ball, placed at such a distance that its apparent diameter, seen from the position of the paper, was slightly larger than that of the sun's disk; 3. Observation No. 1 repeated; 4. Observation No. 2 repeated. Next, the means of observations 1 to 4 were taken. The sun's altitude was determined by a sextant and artificial horizon. One of the sets of 134 observations was made as nearly as possible every hour.

It has been already pointed out, and proved by experiments made at Kew, that the mean chemical intensity of total daylight, for the hours equidistant from noon, is constant. The results of the present series of experiments prove that this conclusion holds good generally. One of the chief results arrived at is that, although the chemical intensity for the same altitude, at different places and at different times of the year, varies according to the varying transparency of the atmosphere, yet the relation, at the same place, between altitude and intensity is always represented by a straight line.

* Abstract of a paper communicated to the Royal Society.

ON THE ACIDS CONTAINED IN CRAB OIL.*

BY WILLIAM J. WONFOR,

[illegible]NT IN THE LABORATORY OF THE GOVERNMENT SCHOOL OF SCIENCE, DUBLIN.

[illegible] is obtained from the nuts of a tree known as *Hylocarpus carapa*, and also as *Carapa* This tree grows abundantly in the forests so of Netherlands) Guiana. The oil is [illegible] the kernels, by boiling them for some [illegible], and then placing them in heaps, and [illegible] for some days. They are next skinned, [illegible]s triturated in wooden mortars, until re-[illegible]te, which is spread out on inclined boards, [illegible]to the sun: the oil is thus melted out, and [illegible]eceiving vessels.

[illegible] obtained the oil as met with in the coun-[illegible]pared in, by native Indians, and hence by [illegible]itive and unskilful methods. It is a semi-[illegible]raceous mass, evolving a penetrating odour. [illegible]elts at 55°. In order to obtain the acids, the saponified with a solution of potassic hydrate, [illegible]e soap obtained dissolved in a large quantity of [illegible]r, to which solution of sodic chloride was added [illegible] excess. The soap thus separated was washed, and again dissolved in water, and that solution decomposed by means of hydrochloric acid. The liberated fatty acids were collected and pressed, and, after having been carefully freed from any sodic chloride, again saponified, and the same treatment repeated; and the soda-soap obtained decomposed with tartaric acid. The melting-point of the mixed acids was 40°.

The author describes, further, at great length, the purification of the acid, and states that its melting-point is 57.°

The acid presents the appearance of a white, glistening mass, which, on being submitted to organic elementary analysis, gave, in 100 parts:—Carbon, 75·00; hydrogen, 12·50; oxygen, 12·50. Formula, $C_{16}H_{32}O_2$. The composition of the argentic palmitate is, $C_{16}H_{31}O_2Ag$.

The author also prepared the ethylic palmitate, $C_{16}H_{31}(C_2H_5)O_2$, and also describes a baric salt. He further states that, for various reasons, he was, to his regret, not enabled to examine quite satisfactorily the acid of the lower melting-point contained in the original saponified and purified mass.

ON THE CHEMICAL EQUILIBRIUM BETWEEN CARBON, HYDROGEN, AND OXYGEN.

BY M. BERTHELOT.

THE following facts are the result of experiments on decomposition of carbonic acid, steam, and the prolonged reaction of the spark on sundry mixtures of hydrogen, oxide of carbon, oxygen, steam, and carbonic acid.

1. *Decomposition of Carbonic Acid.*—This gas, when traversed by a series of induction-sparks, decomposes rapidly. The decomposition reaches a certain limit, then retrogrades, again augments, diminishes, and so on, without tending towards any fixed limit. This is shown by the following table, which demonstrates the volume of gases non-absorbable by potash (oxide of carbon, and oxygen) contained in 100 volumes of the mixture under analysis. The experiment was conducted with 200 c.c. of gas, the sparks, which were strong and slow, proceeding from a Ruhmkorff coil fed by six elements of Bunsen. The specimens were taken and analysed from time to time.

After 5	minutes	.....	13·0	After 99	minutes	.....	7·0
12	"	.....	10·0	110	"	.....	6·0
14	"	.....	9·5	128	"	.....	6·0
24	"	.....	7·5	143	"	.....	5·0
39	"	.....	5·5	153	"	.....	7·0
54	"	.....	10·0	163	"	.....	10·0
84	"	.....	12·5				

The relation 2–1 between the oxide of carbon and the oxygen was verified every time; it exists only when the spark plays between platinum wires placed at a great distance from the mercury, otherwise part of the oxygen is absorbed by the latter. All this tends to establish the important fact that the decomposition of carbonic acid does not tend towards any fixed limit; this is contrary to what occurs during the decomposition of acetylene and many other reactions. This absence of a fixed limit indicates the simultaneous existence of two contrary but independent causes. Of this more anon.

2. The extreme limits between which the decomposition oscillates have no elements of constancy; all depends on the length and intensity of the sparks, as a comparison of the preceding table with the following will show.

			Short sparks.	Very short and feeble sparks.*
After 10	minutes	.....	14·0	..... —
" 15	"	.....	—	..... 6·0
" 25	"	.....	18·0	..... —
" 37	"	.....	19·0	..... 13·5
" 60	"	.....	1·5	..... 29·0
" 82	"	.....	24·0	..... 2.0

These figures show progressive decomposition followed by re-combination.

3. A mixture of 2 volumes of oxide of carbon and 1 volume of oxygen, with a suitable quantity of carbonic acid, does not explode. It is only necessary that the carbonic acid should constitute 60 or 65 hundredths of the entire volume. The limit is still somewhat uncertain, according to the intensity of the sparks. The re-united oxide of carbon and oxygen form, in this instance, from 35 to 40 hundredths of the entire mass.

My next researches related to the limits of the composition of the explosive mixtures formed of oxide of carbon and oxygen.

4. I first of all verified the observations of Dalton, according to whom explosion does not occur in the mixture of the two gases containing less than the fifth, or more than the 14-15ths of its volume of oxide of carbon. These limits vary slightly with the intensity of the spark; moreover, in the same mixture, the combustion is sometimes complete and sometimes incomplete. For instance, a mixture formed of—

Oxide of carbon	18·6
Oxygen	81·4

burnt with flame, all the oxide of carbon being changed into carbonic acid in one experiment; while, in another, only 10·0 of it was formed. The result was similar in limited mixtures in which oxide of carbon predominated, or even oxide of carbon and oxygen in the presence of excess of carbonic acid. These variations are due to the cooling action of the excess of gas.

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* Abstract of a paper read before the Royal Society. Communicated by Dr. Maxwell Simpson.

* Two elements of Bunsen.

5. Can combination be produced below the limit of explosive combustion, and to what extent? It is only known that, at a certain distance within that limit, the combination is explosive and complete, whilst, at a certain distance beyond it, no combination is appreciable under the influence of a single spark.

Now I have perceived that, in all mixtures of oxide of carbon and oxygen beyond the point of explosion, the combination takes place under the influence of a current of prolonged sparks, and that it is completely effected, whatever may be the excess of oxygen or oxide of carbon; for instance, in a mixture formed of—

Oxide of carbon.....	13·0
Oxygen.....	87·0

a current of strong sparks, prolonged during a minute, was sufficient to form 6·5 of carbonic acid; in five minutes, this figure was increased to 13·0. The result was the same with sundry mixtures containing 8·0 and 5·0 of oxide of carbon; the same with mixtures in which oxide of carbon predominated, the oxygen being 3·3 and 1·0, only in the case of these latter more time was required to complete the action. These different results furnished the types of a progressive action, which tends to a complete combination under homogeneous systems.

6. In order to establish the fact more fully, I also worked upon the reciprocal systems, which resulted in complete reaction, whatever were the mixtures of carbonic acid and oxygen, or carbonic acid and oxide of carbon, whose composition approximates to that of systems corresponding to the limit of explosive combustion. Such are the following—

Carbonic acid.....	16·6	Carbonic acid.....	13·0
Oxygen.....	83·4	Oxide of carbon.....	87·0

After being subjected to the sparks for one hour, I discovered exactly the same volume of carbonic acid; therefore the presence of a suitable excess of oxygen or oxide of carbon completely hinders decomposition.

7. It is altogether different in cases where oxygen or oxide of carbon are contained in the mixture in only slight proportions; for instance, a mixture consisting of 96·5 of carbonic acid and 3·5 of oxide of carbon, when subjected to a current of sparks for a quarter of an hour, augmented to 5·1, by reason of the formation of 3·4 of oxide of carbon and 1·7 of oxygen.

Mixtures in which carbonic oxide is mingled at once with oxide of carbon and oxygen, in the proportion of 2 volumes of one to 1 of the other, behave in a particular way; they are reciprocal with those which ensue from the decomposition of carbonic acid, and furnish the same results for an equivalent compound. Thus, the carbonic acid forming less than 60-100ths, the combination is complete and explosive, as has been already stated. Below 60-100ths, the combination is partial, always incomplete, and does not tend towards any fixed limit.—*Comptes Rendus*, vol. lxviii., p. 1035.

ON THE

DETERMINATION OF PHOSPHORIC ACID.*

BY WILLIAM CARLETON WILLIAMS,

STUDENT IN THE LABORATORY OF OWENS COLLEGE.

Of the many methods proposed for the separation of phosphoric acid from the alkaline earths, few are better than the one devised by W. Reissig, founded upon a process originally described by Reynoso. This method, although used in many German laboratories, has, strange to say, found but little favour among English chemists. This is probably owing to the somewhat complicated and tedious nature of the operations required. The modifications described in the following communication considerably simplify the process, and may, possibly, lead to its more general adoption.

Reissig's method depends upon the fact that, when metallic tin is added in excess to a solution of the phosphate of the alkaline earths in nitric acid, the stannic acid formed by the oxidation of the metal combines with the phosphoric acid and completely removes it from solution. On filtering, therefore, we at once separate the alkaline earths which remain in solution from the insoluble combination of stannic and phosphoric acids. In order to determine the amount of phosphoric acid contained in the tin oxide, the compound is dissolved in a small quantity of concentrated potash solution, when the two acids dissolve as meta-stannate and phosphate of potassium; the fluid is now saturated with hydrogen sulphide, a small quantity of ammonium pentasulphide added, and, lastly, a slight excess of acetic acid. The tin sulphide is then separated by filtration; all the phosphoric acid is contained in the filtrate, and its amount may be determined by the ordinary method as magnesium ammonium phosphate.

The chief disadvantage of this method arises from the necessity of employing a large excess of metallic tin, in order to completely remove the phosphoric acid from solution. The bulk of tin sulphide obtained is, therefore, very large, and its filtration and washing is an exceedingly long and tedious operation. In order to shorten the process, Reissig recommends that the alkaline solution of the phosphate and stannate be transferred to a weighed flask of 1000 cubic capacity, and then diluted with water until the fluid measures about 900 cubic; the solution is next saturated with hydrogen sulphide, then ammonium sulphide and acetic acid in slight excess added, and the tincture diluted until the whole weighs 1000 grms. After standing for a few hours the clear supernatant liquid is carefully poured through a filter, taking care not to disturb the precipitate. In the filtrate the phosphoric acid is estimated as magnesium pyrophosphate. The amount of the fluid employed in the determination is ascertained by again weighing the flask. On subtracting the weight of the tin-sulphide calculated from the quantity of the metal originally employed, we have all the data required to determine the amount of phosphoric acid in the entire solution.

This method of proceeding is not altogether faultless in principle. (1) It pre-supposes that from a known weight of tin-foil we are able to calculate the amount of tin-sulphide it will yield. Now the tin-foil of commerce is seldom or never pure, it almost invariably contains a considerable proportion of lead, often amounting to one-third of its weight,* and this of course passes into the nitric acid solution of the alkaline earths. (2) Since only a portion of the phosphoric acid present is actually weighed, the remainder being deduced by calculation, the chances of ultimate error are considerably increased.

These sources of error are removed by simply filtering and washing the tin-sulphide by means of the Bunsen "water-pump," an operation of comparative short duration. We thus obtain the whole quantity of phos-

* Read before the Manchester Literary and Philosophical Society, March 22, 1870. Communicated by Prof. Roscoe, Ph.D., F.R.S.

* The tin-foil employed in my experiments contained 31·35 per cent lead.

phoric acid in solution, and entirely obviate the numerous weighings, involving, too, the very uncertain correction for the amount of tin-sulphide present.

In order to test the trustworthiness of the method thus modified, the following experiments were undertaken. A quantity of pure calcium phosphate was prepared by adding calcium chloride to an excess of sodium phosphate, and the precipitate washed, dried, and ignited. About 0·5 grm. of this compound was weighed out into a porcelain basin, and dissolved in a small quantity of nitric acid; the solution was then concentrated, and the strongest nitric acid (boiling at 86° C.) added until the calcium nitrate commenced to separate out. This was immediately redissolved by the addition of a few drops of dilute nitric acid. The nitric acid solution is now in the highest possible state of concentration: on throwing a small quantity of tin into this solution, the metal is rapidly oxidised to stannic acid, and the supernatant liquid remains perfectly clear. The preliminary heating of the solution is indispensable, since in the cold the metal is apt to become passive, when it completely resists the action of the acid. The precipitate is now dissolved in a small quantity of caustic potash, and saturated with hydrogen sulphide; on adding acetic acid in slight excess the tin-sulphide is precipitated. The precipitate is then separated by means of the Bunsen "filter-pump," and the whole of the phosphoric acid is contained in the filtrate. After concentrating the solution, and again filtering from a minute precipitate of tin-sulphide, which invariably separates out (tin-sulphide being slightly soluble in solutions containing hydrogen sulphide), the phosphoric a cidmay be precipitated as the magnesium ammonium salt, and weighed as pyrophosphate.

I. Ratio of tin to phosphoric acid, 4 to 1.

	$Mg_2P_2O_7$.	P_2O_5.
I. 0·5135 grm. cal. phos. gave	0·405	= 50·45 per cent
II. 0·447 " " "	0·358	= 50·78 "
Mean.....		50·61 "

The lime was determined as caustic lime after removal of the lead by means of hydrogen sulphide. The mean of two concordant analyses gave 49·65 per cent of lime.

Hence the composition of the calcium phosphate is—

Phosphoric acid	50·61
Lime.....	49·65
	100·26

It is, therefore, evident that the amount of pure tin required need not exceed four times the weight of phosphoric acid present.

The following experiments show that this is, moreover, the minimum quantity that can be used.

II. Ratio of tin to phosphoric acid = 3·0 to 1.

	$Mg_2P_2O_7$	P_2O_5
0·477 grm. cal. phos. gave	0·307	= 41 53 per cent

III. Ratio of tin to phosphoric acid = 3·5 to 1.

	$Mg_2P_2O_7$	P_2O_5
0·598 grm. cal. phos. gave	0·388	= 41·50 per cent
0·434 " " "	0·304	= 44·82 "

In order to confirm the above results I have determined the proportion of lime and phosphoric acid contained in the calcium phosphate employed in the analyses, by dissolving the compound in hydrochloric acid, and adding sufficient sulphuric acid to precipitate the base. To each volume of the liquid two volumes of alcohol were added, and the mixture allowed to stand about twelve hours, when it was filtered and the precipitate thoroughly washed with alcohol. The filtrate containing the phosphoric acid is evaporated to dryness, the residue dissolved in water, and the acid precipitated as the magnesium ammonium salt. The lime was weighed as sulphate.

I. 0·525 grm. gave 0·411 MgP_2O_7 = 50·08 per cent P_2O_5
II. 0·507 " " 0·396 " = 49·96 per cent P_2O_5

The lime amounted to 50 per cent. Hence the composition of the calcium phosphate is—

P_2O_5.....	50·02
CaO.....	50·00
	100·02

exactly agreeing with the determinations made by the tin method.

ON THE ETHYLIC SERIES OF SILICIUM.

BY MM. C. FRIEDEL AND A. LADENBURG.

The observations, of which an account is here given, tend to prove the truth of the opinion expressed by M. Dumas, some thirty years ago, that hydrogen was not the only element susceptible of substitution, and that some body might be found capable of replacing carbon.

Sundry articles upon the subject, written first by MM. Friedel and Crafts, and afterwards by ourselves, show, in the first place, that silicium is a tetratomic element like carbon, and deserves comparison with it on that account; but the analogy does not end here. Silicium is capable of acting after the manner of carbon, and serving as a link for several hydrocarbonized groups by furnishing bodies presenting great analogy with certain hydrocarbides, and governed by the same law of saturation, provided the silicium be reckoned as an equivalent of the carbon, atom for atom. From these siliceous hydrocarbides several bodies may be derived, whose residues, containing silicium, united with carbon and hydrogen, and play the part of radicals exactly like simply hydrocarbonized groups. After studying a large number of compounds, forming what may be called the methylic group of silicium, it was necessary to find bodies corresponding to more elevated groups of the carbon series, and thus to show that silicium in groups analogous to organic compounds, may not only be saturated by atoms of carbon, but partakes with that element the property of saturating itself at least partially. This was at last effected after numerous fruitless attempts.

Upon endeavouring to remove from chloride of silicium a portion of the chlorine contained in it, so as to change it into a chloride more complex by one molecule, the silicium will be completely reduced if a metal be employed, such as sodium, zinc, or silver. In the case of hydrogen, which was used by Ebelmen for preparing sesquichloride of titanium, only a small quantity of silicichloroform was obtained.

It was believed that the iodine of silicium, SiI_4, discovered by one of us, would be attacked at a low temperature and would thus become better adapted to the end in view; experiments have justified the supposition. The iodide was heated for some hours at a temperature approaching its boiling point (290°—300°) with perfectly dry and powdery silver. The tetraiodide was then transformed into a white mass presenting a totally different aspect from its primitive appearance. Upon treating the contents of the vessel with a small quantity of sulphide of carbon, to extract any remains of tetra-

iodide, and after several washings, dissolving it in a large quantity of hot sulphide of carbon, the product consisted of beautiful colourless crystals, in hexagonal prisms or rhomboidal bases, acting upon polarised light after the manner of doubly refracting substances, and which fume in the air and decompose, forming a white substance. When treated with potash, a lively evolution of hydrogen ensues.

Analysis proves that these crystals are the iodide desired, Si_2I_6, formed by deducting one atom of iodine from the tetraiodide, and re-combining the two residues (SiI_3). The quantity of hydrogen evolved by the action of the potash confirms the result of the analysis, being $_2H$ in Si_2I_6, which should be, according to the equation—

$$Si_2I_6 + 4H_2O = 2SiO_2 + 6HI + 2H.$$

The hexa-iodide of silicium cannot be distilled either under atmospheric pressure or in a vacuum. It sublimes partially, but decomposes to a great extent into tetraiodide, leaving an orange-red residue, whose composition corresponds to the formula SiI_2, and which is insoluble in sulphide of carbon, benzol, chloroform, and chloride of silicium. This last iodide is changed by water into a white or greyish mass, evolving much hydrogen in the presence of potash. The hexaiodide melts in a vacuum, but with partial decomposition at a temperature of 250°. It is much less soluble than the tetraiodide in sulphide of carbon at 27°; one part of this liquid dissolves 2·2 parts of SiI_4 and only 0·26 of Si_2I_6. When crystals of the hexaiodide are thrown into iced water, they decompose without evolution of hydrogen, and the white substance, which remains when dried in a vacuum at 100°, presents a composition corresponding to the formula $Si_2O_4H_2$, which is proved by the quantity of hydrogen disengaged by the potash or collected as water, by combustion with oxygen, and by calcining the mass which decomposes with incandescence, and an evolution of hydrogen, leaving a residue of silica, whose weight is almost identical with that of the primitive substance. The iodide of silicium is transformed into a hydrate, $Si_2(OH)_6$, upon contact with water; this hydrate loses $2H_2O$ to form the body, $Si_2O_4H_2$, whose composition is analogous to oxalic acid, and which may be called silici-oxalic hydrate.

Salts of this compound could not be obtained. They became decomposed by even the weakest bases, with evolution of hydrogen, as is done by potash under other circumstances in the case of oxalic acid.

Several reactions were tried with the hexaiodide with a view to obtaining a volatile compound without decomposition. After ascertaining that bromine extracts all the iodine from the iodide, and transforms it into a bromide, and that the iodine is capable of reacting on alcoholate of soda, and thus forming an ethereal compound, the action of zinc-ethyl on the hexaiodide was next examined.

Upon mixing the latter with the former in small portions at a time, and gently heating it, a reaction is produced, and a white substance precipitated. When a suitable proportion of iodine (Si_2I_6 for $3ZnEt$) has been added, the reaction is finished; it is then distilled, and the distilled product treated with water to decompose a slight excess of zinc-ethyl. After decanting the water, it is repeatedly washed in concentrated sulphuric acid to remove a substance which is soluble in that liquid, and which appears to be triethyl oxide of silicum. It is then again washed with water, dried, and fractionally distilled; two liquids are thus separated; one, boiling at from 150° to 154°, is siliciumethyl, $Si(C_2H_5)_4$; and the other, which was obtained between 250° and 253°, gives, on analysis, numbers agreeing with the formula $Si_2(C_2H_5)_6$. It is a limpid liquid, with a faint smell, resembling that of siliciumethyl and burns with a brilliant flame, giving forth fumes of silica. Upon ascertaining the density of vapour, the figures obtained approached very nearly to those required by the theory for the formula $Si_2(C_2H_5)_6$, but somewhat higher (theory 7·96 exp. 8·5). The liquid does not alter sensibly at 300°, but alters slightly, with formation of a product soluble in sulphuric acid, which is doubtless triethyl oxide of silicium, $Si_2O(C_2H_5)_6$, which is formed, by oxidation of siliciumhexethyl. The presence of this body expains the slight excess of the found density as compared with the theoretical density. The exactitude of the formula, $Si_2(C_2H_5)_6$, is beyond doubt; consequently the series of compounds here spoken of certainly belong to the ethylic group of silicium. The two atoms of silicium are directly connected, and serve as a link to the atoms of iodine, or of oxygen and hydroxyl, or ethyl, which combine with them to form the molecule. The reaction of the zinc ethyl upon the hexaiodide takes place in an exactly similar manner to that of the same body upon the chloride and the iodide of silicium, and furnishes a compound which may be considered as homologous with siliciumethyl. The study of the reactions of this body will doubtless be interesting, and will probably show that the analogy is not confined to the formulæ.—*Comptes Rendus.*

ON THE COMPOSITION OF THE WATER OF THE IRISH SEA.*

BY T. E. THORPE, PH.D., AND MR. E. H. MORTON.

Thanks to the investigations of Forchhammer, Von Bibra, Bischof, and others, our knowledge concerning the nature and distribution of the saline constituents of sea-water and of the causes of the variations in its composition as observed in various parts of the world, is tolerably extensive and precise. English chemists, however, have contributed next to nothing to the general stock of our information on this subject. This is not a little remarkable, especially when we consider the peculiarly favourable condition in which this country is placed for researches of this kind, by reason of its insular position. A few observations by John Davy made in the course of his long voyages, two memoirs by Marcet in the "Philosophical Transactions" for 1819 and 1822 on the temperature and saltness of various seas, and an elaborate analysis by Schweitzer of the water of the English Channel made in 1838, constitute by far the chief portion of the work done in this direction by English chemists. The chemical history of the sea is mainly to be derived from the researches and observations of chemists principally French and German, the majority of whom are located at considerable distances from the sea-board, and who laboured therefore under all the disadvantages which this circumstance necessarily entails. So far as we can learn the water of the Irish Channel has never been analysed. We have been induced, therefore, to undertake its analysis in the hope of supplying information respecting the nature and extent of the modifications effected in the composition of the sea by its proximity to our coasts. Accordingly

* Read before the Manchester Literary and Philosophical Society, March 22, 1870.

Captain Temple of the "Bahama Bank" Light Ship kindly collected for us a quantity of the water in the immediate neighbourhood of his vessel. The vessel is situated in lat. 54° 21′ N. and long. 4° 11′ W., seven miles W.N.W. of Ramsey, Isle of Man, and is placed nearly equi-distant from the shores of England, Scotland, and Ireland. During the greater part of the day a strong current setting in from the south, probably from the Atlantic, flows past the ship into the North Channel, and thence again into the Ocean. The water, therefore, taken for analysis, was originally that of the deep ocean, which had traversed almost the entire length of the Irish Channel, and had consequently been exposed to all the influences due to the neighbouring sea-board, and to the influx of the numerous rivers along the coasts.

The water was obtained in the early part of January, 1870; the meteorological conditions at the time of collection, and for some time previously, were in no wise remarkable. The analysis was commenced immediately on receipt of the water. Its specific gravity compared with distilled water, free from air, and possessing the same temperature, was found to be—

At 0° C.	1·02721
At 15° C.	1·02484

These numbers differ but slightly from that usually accepted as representing the mean specific gravity of the water of the ocean. The water of the Atlantic, according to Von Horner, possesses the specific gravity 1·02875 at 0° C.; that of the English Channel at 15·5° was found by Schweitzer to be 1·0271: on nearing the land the specific gravity fell to 1·0268.

Full details of the methods of analysis employed are given in the original paper. The following synopsis shows the mean results of the determinations: the numbers express the amount of the various ingredients in 1000 grms. of the sea-water.

1 Chlorine	18·62650
2 Bromine	0·06133
3 Sulphuric acid (SO_4)	2·59280
4 Lime (total)	0·57512
5 Calcium carbonate	0·04754
6 Magnesia	2·03233
7 Mixed alkaline chlorides	27·18363
8 Potassium	0·39131
9 Sodium	10·40200
10 Ferric oxide	0·00465
11 Ammonia	0·00011
12 Nitric acid	0·00156
13 Fixed constituents	33·83855

These substances, arranged on the assumption that the strongest acid is united with the strongest base, yield the following numbers:—

Sodium chloride	26·43918
Potassium chloride	0·74619
Magnesium chloride	3·15083
Magnesium bromide	0·07052
Magnesium sulphate	2·06608
Magnesium carbonate	traces
Calcium sulphate	1·33158
Calcium carbonate	0·04754
Lithium chloride	traces
Ammonium chloride	0·00044
Magnesium nitrate	0·00207
Silicic acid	traces
Ferrous carbonate	0·00503
	33·85946
Amount directly determined	33·83855

The water employed in the foregoing analysis was collected in midwinter. It becomes interesting to know if its composition is uniform during the various seasons of the year. Fortunately we can offer some evidence on this point. In August, 1865, after a continuance of exceptionally fine weather, one of us collected some sea-water in the neighbourhood of the "Bahama Bank" Light Ship, and determined the total quantity of its saline constituents, together with the amount of chlorine and sulphuric acid. The proportion of solid matter contained in the water of the Irish Sea is somewhat greater in summer than in winter—the variation amounting to 0·0144 per cent—but the relative amount of solid matter present in the water of the Irish Channel is invariably less than is contained in the water of the Atlantic Ocean lying between the same parallels.

According to Forchhammer, the mean proportion of the leading constituents of the water of the Atlantic far away from the shores is as follows:—

	Cl.	SO_3.	CaO.	MgO.	Total Salts.
Absolute amount in 1000 grms.	19·865	2·362	0·588	2·199	35·976
Relative amount	100	11 89	296	11·07	181·10

Arranged in this manner, our determinations on the water of the Irish Sea give the following proportions:—

		Cl.	SO_3.	CaO	MgO.	Total Salts.
Absolute amount per 1000 grms.	Summer.	18·735	2·187	—	—	34·082
	Winter.	18·627	2·161	0·575	2·032	33·838
Relative amount.	Summer.	100	11·67	—	—	181·91
	Winter.	100	11·63	3·09	10·93	182·09

RESEARCHES ON VANADIUM.*

Part III. Preliminary Notice.

BY HENRY E. ROSCOE, B.A., F.R.S.

I. Metallic Vanadium.

In the second part of "Researches on Vanadium," it was stated that the metal absorbs hydrogen. This conclusion has been fully borne out by subsequent experiment: and it appears that the amount of absorbed or combined nitrogen taken up by the metal varies according to the state of division—first, of the chloride (VCl_2) from which the metal is prepared, and secondly, and especially, of the metal itself. The metal containing absorbed hydrogen slowly takes up oxygen on exposure to the air, water being formed and the metal undergoing oxidation to the lowest oxide, V_2O. At this point the oxidation stops.

The difficulty of obtaining metallic vanadium free from admixture of oxide has been again rendered evident. Perfectly pure tetrachloride was prepared in quantity, and from this pure dichloride was made. On heating this to whiteness for forty-eight hours, a substance was obtained which gained, on oxidation, 70·7 per cent (vanadium requiring 77·79 percentage increase), and, therefore, still contained a slight admixture of oxide.

The reducing action of sodium on the solid chlorides was next examined; in this case, the reduction takes place quietly in an atmosphere of hydrogen at a red heat, and is best conducted in strong iron tubes. Explosions occur when sodium acts on the liquid tetra-

* Read before the Royal Society, April, 1870.

chloride. The substance thus obtained was found, after lixiviation, to be free from chlorine, and on washing it separated into two portions—(1) a light and finely-divided black powder (trioxide), which remains in suspension, and is soluble in hydrochloric acid; and (2) a heavier grey powder, insoluble in hydrochloric acid, which soon deposits, and can, by repeated washing, be completely freed from the lighter trioxide. This bright grey powder consists of metallic vanadium, mixed with more or less oxide. If this metallic powder, after drying *in vacuo*, be reduced at a low red heat in a current of pure hydrogen, the powder, even when cold, on exposure to air or oxygen, takes fire spontaneously, water being formed, whilst the vanadium undergoes oxidation, forming the blue oxide, V_2O_4. A portion of metal exposed for some weeks to the air also slowly absorbed oxygen, pasing into the oxide, V_2O.

II. Vanadium and Bromine.

1. *Vanadium Tribromide*, VBr_3; molec. wt. = 291·3.—When excess of bromine is passed over vanadium mononitride heated to redness, a vivid action occurs, and dense dark-brown vapours are formed, condensing in the cooler portions of the tube to a greyish black, opaque, amorphous mass of the tribromide. The tribromide is a very unstable compound, losing bromine even when kept sealed up in glass tubes; it is very deliquescent, and, on heating in the air, rapidly loses all its bromine and takes up oxygen, with formation of vanadic acid. On being thrown into water, the tribromide readily dissolves, forming a brown liquid (in this respect resembling the trichloride), which, on addition of a few drops of hydrochloric acid, turns of a bright green colour, showing the presence of a solution of an hypovanadic salt. No free bromine or hydrobromic acid is given off on dissolving the tribromide in water. That a more volatile higher bromide was not formed in this reaction was shown, inasmuch as, on distilling the excess of liquid which had collected in the receiver, it was found to consist of free bromine, containing mere traces of the tribromide mechanically carried over. The tribromide is likewise formed when bromine is passed over a red-hot mixture of vanadium, trioxide, and pure charcoal, as in the preparation of the tetrachloride; but this method is not one to be recommended, as the tube becomes constantly stopped up by the formation of the solid tribromide.

The analysis of the tribromide was made by dissolving the compound in water, and precipitating the bromine with excess of nitrate of silver, the vanadium being estimated as V_2O_5, either in the filtrate from the bromide of silver or in a separate portion. The bromine in the above determinations, obtained by precipitation as silver-salt, was invariably found to be too high, whilst the vanadium nearly agreed with the theoretical percentage. This is due to the fact pointed out by Stas, in his "Recherches" (p. 156), that bromide of silver, when boiled, encloses, mechanically, a portion of the precipitant, which then cannot be washed out. The loss of weight obtained by reducing the bromide to metallic silver in a current of hydrogen, taken as bromine, gave more nearly agreeing numbers:—

		Calculated.	Mean of 6 determinations.
Vanadium.....V	= 51·3	17·61	18·44
			Mean of 3 determinations.
Bromine.....Br_3	= 240·0	82·39	80·86
	291·3	100·00	99·30

2. *Vanadium Oxytribromide*, or *Vanadyl Tribromide*, $VOBr_3$, molec. wt.=307·3.—The oxytribromide is a dark-red transparent liquid, evolving white fumes on contact with the air, obtained by passing pure and dry bromine over vanadium trioxide (V_2O_3) heated to redness. Moisture prevents the formation of the oxytribromide; and it not only undergoes sudden decomposition when heated to 180°, but also slowly decomposes at the ordinary atmospheric temperatures. The boiling-point of the tribromide can, however, be brought below the temperature of decomposition by distillation *in vacuo*, and the liquid can then be freed completely from bromine by passing a current of dry air through the liquid. Under a pressure of 100 m.m., the oxytribromide boils from 130° to 135, and may be distilled almost without decomposition. Vanadium oxytribromide dissolves in water, yielding a yellow-coloured solution, in which both vanadium and bromine were determined, after reduction with sulphurous acid—

		Calculated.	Mean of several analyses.
V.....	= 51·3	16·69	16·75
Br_3.....	= 240·0	78·10	79·20
O.....	= 16·0	5.21	——
		100·00	

The sp. gr. of the oxytribromide, at 0°, is 2·967.

3. *Vanadium Oxydibromide*, or *Vanadyl Dibromide*, $VOBr_2$, molec. wt.=227·3.—This is a solid substance, of a yellowish-brown colour, obtained by the sudden decomposition of the foregoing compound at temperatures above 100°, or by its slow decomposition at the ordinary temperature.

The oxydibromide is very deliquescent, dissolving in water, with formation of a blue solution of a vanadious salt. When heated in the air, it loses all its bromine, and is converted into V_2O_5.

Analysis gave—

		Calculated.	Mean of several analyses.
V.....	= 51·3	22·570	22·45
Br_2.....	= 160·0	70·390	70·93
O.....	= 16·0	7·104	——
	227·3	100·000	

III. Vanadium and Iodine.

Iodine vapour does not attack either the trioxide or the nitride at a red heat; both these substances remain unchanged, and no trace of vanadium can be detected in the iodine which has passed over them.

IV. The Metallic Vanadates.

In the first part of these Researches (*Phil. Trans.* 1868), it was pointed out (1) that the salts analysed by Berzelius must be considered as meta- or mono-basic vanadates, (2) that the so-called bivanadates analysed by Von Hauer are anhydro-salts, and (3) that the ortho- or tribasic vanadates contain 3 atoms of monad metal, the sodium salt being formed artificially by fusing 1 molecule of vanadium pentoxide with 3 molecules of carbonate of soda, when 3 molecules of carbon dioxide are expelled, whilst the orthosalts occur native in many minerals. The present communication contains a description of these classes of salts, as well as of a new class of salts, the tetrabasic or pyro-vanadates.

Sodium Vanadates.

I. *Ortho-* or *Tri-Sodium Vanadate*, $Na_3VO_4 + 16H_2O_2$.—When a mixture of 3 molecules of Na_2CO_3 and 1 mole-

cule of V_2O_5 is fused until no further evolution of CO_2 is observed, a tribasic vanadate remains as a white crystalline mass. This mass dissolves easily in water, and on addition of absolute alcohol to the solution two layers of liquid are formed; the lower one solidifies after a time, forming an aggregation of needle-shaped crystals, which possess a strongly alkaline reaction. These having been washed with alcohol, and dried on a porous plate over sulphuric acid *in vacuo*, were analysed with the following results:—

		Calculated.	Found.
Na_3	= 69·0	14·60	13·80
V	= 51·3	10·86	10·86
O_4	= 64·0	13·56	—
$16H_2O$	= 288·0	60·97	60·44
	472·3	99·99	

The sodium in this and in the following compounds was separated from the vanadium by precipitating the vanadic acid as the perfectly insoluble basic lead salt hereafter described. This was dried at 100° and weighed, then dissolved in nitric acid and decomposed by sulphuric acid, and the solution of V_2O_5 in excess of this acid gave, on evaporation, a finely crystalline mass. The filtrate from the lead precipitate freed from lead yielded on evaporation sodium sulphate. Full analytical details of this method, as well as of the other by precipitation, as the insoluble ammonium metavanadate, are given in the memoir. By frequent crystallisations the tri-sodium vanadate is slowly decomposed into the tetrasodium salt, caustic soda being formed. This singular reaction was most carefully examined and the amount of sodium hydroxide liberated determined diametrically.

2. *Tetrasodium Vanadate*, $Na_4V_2O_7 18H_2O$.—This salt crystallises in beautiful six-sided tables. It is easily soluble in water, insoluble in alcohol, and is precipitated by the latter liquid from aqueous solution in white scales of a silky lustre. As long as the salt contains free alkali or tribasic salt, it forms, on precipitation with alcohol, oily drops which solidify after some time. The tetrasodium vanadate is always formed by the first fusion of vanadic acid with excess of carbonate of soda, and can be easily prepared in the pure state by re-crystallisation.

	Calculated.	Found (mean of several determinations).
Na_4 =	92·0	14·58	14·61
V_2 =	102·6	16·27	15·97
O_7 =	112·0	17·27	—
$18H_2O$ =	324·0	51·38	51·80
	630·6	99·99	

The salt loses 17 molecules of water at 100°.

The corresponding Calcium and Barium Vanadates, $Ca_2V_2O_7$, and $Ba_2V_2O_7$ are white precipitates obtained by adding the chlorides to a solution of tetrasodium vanadate. If calcium chloride be added to a solution of the trisodium salt, dicalcium vanadate is precipitated, the solution becoming strongly alkaline from formation of calcium hydroxide and absorbing carbonic acid from the air. Complete analysis showed that the calcium salt contains $2\frac{1}{2}$ molecules of water of crystallisation, whilst the barium salt is anhydrous.

Lead Vanadates.

1. *Tribasic* or *Ortho-Lead Vanadate*, $Pb_3 2(VO_4)$.—Obtained as a light yellow insoluble powder on precipitating the tribasic sodium salt with a soluble lead salt; it yielded on analysis 11·75 per cent of vanadium, the calculated quantity being 12·04 per cent.

2. *Vanadinite, the Double Ortho-vanadate and Chloride of Lead*, $3Pb_3VO_4 + PbCl_2$, can be artificially prepared by fusing for a few hours a mixture of vanadic acid, oxide of lead, and chloride of lead, in the above proportions, together with an excess of sodium chloride. After cooling, a greyish crystalline mass is left, containing cavities filled with long crystals having the same colour as the mass, which under the microscope could be distinguished as six-sided prisms. The crystalline powder is then boiled with water until no further traces of soluble chlorides are extracted.

The following analysis shows that this substance has the same composition as the vanadinites from Zimapan and Windischkappel, analysed by Berzelius and Rammelsberg.*

	Calculated. $3(Pb_3VO_4)PbCl_2$.	Natural vanadinite. Zimapan, Berzelius.	Windischkappel, Rammelsberg.	Artificial. vanadinite.
Lead	73·08	70·40	71·20	71·96
Vanadium	10·86	—	9·77	11·11
Chlorine	2·50	2.54	2·23	2·31
Oxygen	13·55	—	—	—

The specific gravity of the artificial vanadinite at 12° C. is 6·707, that of the natural being 6·886.

3. *Basic Di-Lead Vanadate*, $2(Pb_2V_2O_7) + PbO$.—Acetate of this salt is precipitated as a pale yellow powder when lead is added to a solution of disodium vanadate, the liquid acquiring an acid reaction. It is completely insoluble in water and in dilute acetic acid, but dissolves readily in nitric acid.

		Calculated.	Mean found.
Pb_5	= 1035·0	69·92	70·18
V_4	= 205·2	13·86	13·30
O_{15}	= 240·0	16·22	—
	1480·2		

Silver Vanadates.

1. *The Ortho-silver Vanadate*, Ag_3VO_4, is obtained as an orange-coloured precipitate by mixing a freshly prepared solution of the trisodium salt with a solution of silver nitrate, in which every trace of free acid has been neutralised; unless these precautions are attended to, the precipitate consists of a mixture of the ortho- and pyro-salt. The tri-silver vanadate is insoluble in water, but readily dissolves in ammonia and nitric acid. Analysis gave the following results:—

		Calculated.	Found (mean).
Ag_3	= 324·0	73·75	73·83
V	= 51·3	11·67	11·76
O_4	= 64·0	14·58	—
	439·3	100·00	

2. *The Tetrabasic Silver Vanadate*, $Ag_4P_2O_7$, is prepared by mixing a solution of the corresponding sodium salt with a neutral solution of nitrote of silver. It falls as a yellow dense crystalline precipitate, resembling in colour the ordinary phosphate of silver. On dissolving the salt in nitric acid, the silver is precipitated as chloride, and the vanadium determined as V_2O_5.

Analysis gave:—

		Calculated.	Found.
Ag_4	= 432·0	66·81	66·45
V_2	= 102·6	15·87	15·97
O_7	= 112·0	17·32	—
	646·6	100·00	

* Pyromorphite and apatite have already been artificially prepared by Deville and Caron, and also by Debray, whilst mimetesite has been obtained artificially by Lechartier.

I have to thank Messrs. Œhofer and Finkelstein for the valuable assistance which they have given me in the above investigation.

NOTE ON THE

DOUBLE ARSENIATE OF MAGNESIA AND AMMONIA.

BY FREDERICK FIELD, F.R.S.

Many years ago I published in the *Quarterly Journal of the Chemical Society*, vol. xi., p. 6, a paper "On the Composition of the Double Arseniate of Ammonia and Magnesia," after a long investigation of the subject. Mr. E. W. Parnell in the Chemical News (vol. xxi, p. 133; *Am. Reprint, May*, '70, *page* 256), has also written an elaborate memoir on the same substance, and he arrives at the conclusion that at about a temperature of 90° C. ammonia escapes, but more than one equivalent of water is retained, while at a temperature of from 100° to 110° C. this excess of water, and probably more ammonia are driven off, and, therefore, considers that no definite compound of arsenic can be obtained by drying the precipitate at a temperature at all suitable for counterpoised filter.

Without impugning for one moment the accuracy of Mr. Parnell's analyses, my own experiments seemed so fully to corroborate the excellence of Levot's method for the estimation of arsenic by the formation of the double arseniate, recognised as most satisfactory both by H. Rose and Fresenius, and recommended by those chemists, that I was led to study Mr. Parnell's experiments attentively to see if our methods of working were identical. In referring to the *Quarterly Journal of the Chemical Society*, vol. xi., p. 13, it will be found that it is very necessary to be extremely cautious in the desiccation of the substance in question. Specimens dried upon a filter placed above a sand bath with a thermometer suspended at the same distance from the heated surface (the mercury never rising above 300° F.) were found to have lost the whole of their water in from four to five hours, and from more recent experiments it has been proved that no water can exist even at 230° F. Again, it is stated on the same page, "like the corresponding lime salt, it loses water at a slight increase of temperature (the lime salt loses its equivalent of water at a little above 212° F.)."

Now, upon a careful perusal of Mr. Parnell's paper it appears that a *constant* temperature of 100° C., except in one instance, was not employed, the thermometer ranging from 90° to 100° C. He is, therefore, quite correct in saying that at 90° more than one equivalent of water is retained (*vide Quarterly Journal of the Chemical Society*, vol. xi., p. 13), and also that from 100° to 110° C. the excess of water is driven off.*

Mr. Parnell obtains, in one experiment, where the arsenic has been thoroughly oxidised by the passage of chlorine through the arsenic acid solution, 0·1690 of arsenious acid from 0·3244 of the double arseniate, a result, he observes, far too low, and which leads him to believe that the formula $(AsO_4,MgNH_4O)2H_2O$ does not represent the composition of the compound after being dried at 100°—110° C. Certainly it does not, for the composition of the double arseniate above 100° C. contains no water, and the calculated quantity of arsenious acid obtained by drying the arsenical compound above 100° C. should be 0·173, not very much above Mr. Parnell's figures. Again, when 1·0152 grms. of air-dried compound were heated in the air bath, at a temperature of 100°—110°, the mean loss by weight in three experiments gave Mr. Parnell 37·86 per cent. In my experiments the loss was 37·41, no very great discrepancy, when reduced to percentages.

With regard to the evolution of ammonia at temperatures under 100° C., I confess it is a matter of grave interest, and has escaped the observation of all former analysts. Rose himself has given the formula of the compound dried at 100° $(NH_4O,2MgOAsO_5)HO$ (old notation), and this has been corroborated by many chemists. I have always noticed the smell of ammonia, and its action upon litmus, when drying the substance, but concluded that it arose entirely from the liquid in which the precipitate was washed upon the filter, and which was always made strongly alkaline, as the double arseniate is far more insoluble in ammonia than in either water or chloride of ammonium.

Mr. Parnell's experiments, therefore, in some respects coincide with my own, inasmuch as he proves that under 100° C. more than one equivalent of water exists, and that above that temperature, according to his own figures (with a slight margin for necessary error), no water exists.

ON CONSECUTIVE POLES IN A MAGNET.

BY CHARLES TOMLINSON, F.R.S.

In the Chemical News (vol. xxi., p 164; *Am. Repr., June*, '70, *page* 343) is an account, by Mr. Porter, of some "curious results in the shape of magnetic phenomena." These results refer to the production of what are called, by English writers on magnetism, *consecutive poles;* by the French, *points conséquens;* and, by the Germans, *Folgepunkte*. Although the phenomena which accompany their production are interesting and instructive, they are scarcely noticed in the modern treatises that are in general circulation. Snow Harris, in his "Rudimentary Magnetism," does not describe them, probably for the reason given by Becquerel ("Traité de l'Electricité," vol. i., p. 73)—that a needle containing consecutive points is worthless in observations on terrestrial magnetism. Some of the old treatises give a sufficient account of them; thus, in Cavallo's "Treatise on Magnetism" (second edition, 1795), the following passage occurs at p. 186:—"The magnetic centre, or the limit between the polarities, is not always in the middle of the bar; it is generally nearer that end which is presented to the magnet. This difference is greater as the magnet is weaker and the length of the bar increases; but, when the bar exceeds a certain length (which depends on the strength of the magnet), then the bar acquires several successive poles—viz., when the north pole of the magnet is contiguous to one of its extremities, that extremity becomes a south pole; a few inches farther on you will have a north polarity; then another south polarity, and so on. In this case, the first magnetic centre comes very near that end of the bar which stands next to the magnet, and other magnetic centres are formed between every pair of successive poles: those successive poles become weaker and weaker in power, according as they recede from that end of the bar which is contiguous to the magnet; so that, in a pretty extended bar, they quite vanish long before they come to the farther end of it. Hence, if one pole of a magnet be applied to the end of a long bar, the other end of the bar will not thereby acquire any magnetism."

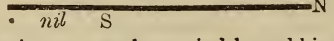
* In Mr. Parnell's paper, "the excess of water and probably more ammonia."

[English Edition, Vol. XXI., No. 543, page 185; No. 544, page 193.]

An effect of this kind may be well shown by magnetising one-half only of a steel knitting-needle about nine inches long.

Experiment 1.—Place a steel knitting-needle on the table, and press it down firmly, by means of a finger, in the middle of its length; then draw the south pole of a strong magnet along the wire, from the finger to the end, about six or eight times, bringing the pole, after each touch, with a wide sweep of the arm, back to the finger. If now the wire be tested, by holding it vertically near a horizontal magnetic-needle, the end of the touched half will be found to be N.; while the S. pole will be somewhere within the wire, at about 5 inches from the N. pole, and the rest of the wire inactive. On dipping the N. end into iron-filings, a considerable bunch will be taken up. On dipping the other end into the filings, it will attract none of them, until the filings reach the wire at and about S. (Fig. 1), where a large bunch will be taken up.

Fig. 1.



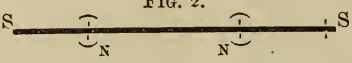
This experiment may be varied by rubbing the N. or S. pole of a strong magnet over about an inch or two of the central portion of a knitting-needle 9 inches long. All three poles will be within the wire, an inch or more at each end being magnetically inactive.

The following experiment will show the action of consecutive poles:—

Experiment 2.—A bar-magnet, 6 inches long and ½ inch wide, was touched six times on its marked or northern half with the north end of a strong magnetic battery. On passing the bar horizontally before a small dipping-needle, the marked end of the bar strongly attracted the marked end of the needle. At the distance of 1½ inches from the marked end of the bar, the needle suddenly swung round, and presented its S. pole to the bar, and continued to do so until a part of the bar, 1¼ inches from the other end, arrived opposite the needle, when this again swung round, and presented its N. pole to the bar for the remainder of its length.

Experiment 3.—The bar being placed on the table, and covered with a sheet of white paper, iron-filings were gently sifted upon it. The resulting figure was very good, showing the poles and neutral lines distinctly. Fig. 2 represents roughly the conditions of the case—

Fig. 2.



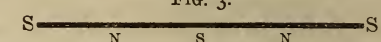
A similar case being produced in a knitting-needle—

Experiment 4.—The needle was broken in the middle, when each fractured end remained a N. pole, the other two ends S. poles, and the neutral point was in the centre of each fragment.

Although, theoretically, the pole is a point situated some way within each end of the bar, in which point all the forces of one kind or other are supposed to be collected (just as the centre of gravity is a point within a body in which all the weight is supposed to be collected), yet, in practice, each half of the bar is often referred to as a pole; and, in the case before us, a considerable portion of the centre of the long wire may be taken as a north pole, bounded on either side by a neutral line, and by a considerable portion of each end which forms a south pole. The extent of north pole in the central portion of the wire is such that it may (as in Experiment 4) be cut through without disturbing the arrangement, each half being now a complete magnet, with the poles and neutral line arranged exactly as they were before the separation; and, further, when the severed ends are brought together, and iron-filings dusted over the whole length, the same figure is produced as before the separation.

Experiment 5.—A knitting-needle was placed on white paper, and the first quarter of its length rubbed with the north pole of a bar-magnet, the second quarter with the south pole, the third with the N., and the fourth with the S. The result of this operation was a needle with five poles—

Fig. 3.

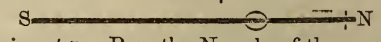


Consecutive poles are due to several causes—such as an over-exertion of the coercitive force, as when we attempt to saturate a bar of steel of too great a length. According to Coulomb, consecutive poles are always formed in needles of tempered steel, where the length exceeds thirty times the diameter. Or, if the steel be of too hard a temper, or of unequal temper, these points are likely to occur from the unequal distribution of the coercitive force. In some cases, they may be made to disappear by a careful re-magnetisation.

According to Coulomb, the neutral line is always brought some millimetres nearer the part of the bar last touched. This may be roughly but strikingly shown by restoring the bar-magnet (Fig. 2) to its natural condition as to polarity.

Experiment 6.—Pass the S. pole of a powerful magnet three or four times over the marked end of the bar (Fig. 2). The two consecutive poles will disappear; but the neutral point will be at about 2 inches, instead of 3, from the marked end, as in Fig. 4.

Fig. 4.



Experiment 7.—Pass the N. pole of the magnet two or three times over the S. end of the bar (Fig. 4), and the neutral point will be at, or very near, the centre.

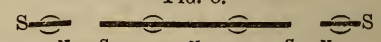
When a long, magnetised knitting-needle has one of its poles reversed, and two consecutive poles formed, the neutral points are not distributed symmetrically.

Experiment 8.—Rub the N. pole of the magnet over the N. end of the needle about three times. The needle will have a S. pole at each end, and the N. pole spread over the centre. The neutral lines will be at 1¾ inches from the original S. pole, and 2½ inches from the reversed N. pole, as in Fig. 5.

Fig. 5.

Experiment 9.—Cut off the two ends of Fig. 5 a little on the S. side of each neutral line. The central portion will be constituted as before—viz., with two extreme S. poles and two inner N. poles, only the neutral points will be brought nearer together. Each of the end fragments is a perfect magnet, with the S. poles undisturbed and the N. poles at the fractured ends, the neutral point being in the middle. Each end of the central piece will lift each fragment by the broken end, and the three pieces being put together in proper order appear thus:—

Fig. 6.



Experiment 10.—Rub N. pole of battery over the N. end of one of the short pieces (2½ inches long) marked

S. N. The effect is simply to reverse the poles, without producing consecutive ones.

If a similar experiment be performed on a regularly magnetised wire not under about 4 inches long, the effect will not, in general, be simply to reverse the poles, as in Experiment 10, but to produce a pole of the same name at each end, while the pole of opposite name occupies the middle portion of the wire, as in Figs. 2 and 5, and the central portion of Fig. 6. Only it must be observed that, in magnetised pieces of steel wire of about 4 inches in length, the end rubbed with the pole of a strong magnet may so far disturb the arrangement of the neutral lines that one may come very near one end, so as to make it somewhat difficult to detect the two poles which such line separates, at least by the dipping-needle or horizontal magnet test. The figure formed by gently dusting iron-filings over it is an elegant and good test.

Experiment 11.—A magnetised wire, 4½ inches long, had its northern half rubbed with the N. pole of a strong magnet. Fig. 7 represents the magnetic wire before this treatment, and Fig. 8 the result of the treatment. It will be seen from Fig. 8 that the neutral point on the side rubbed is 1½ inches from the rubbed end, while the other neutral point is only ⅝ inch from the other end.

Fig. 7.

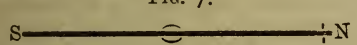
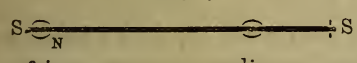


Fig. 8.



I trust the majority of the readers of the Chemical News will excuse the rudimentary nature of the foregoing details into which I have been tempted by what I think are the insufficient descriptions of Mr. Porter. The student may find amusement and instruction in repeating and devising such experiments as have been described. The apparatus required does not necessarily consist of more than a sixpenny horseshoe-magnet, a small compass-needle, a few thin steel knitting-needles, some iron filings contained in a gauze bag or on a small sieve, and a sheet or two of writing-paper. In order to bring out the effects strongly, I used a magnetic battery, capable of lifting about 20 lbs. weight, for magnetizing the wires, and a small, delicately-poised dipping-needle for testing them; but nothing can be more graphic than the iron filings test, and the filings may be gently dusted on the wire itself or on the white paper placed upon it, assisting the figure, if necessary, by a few taps under the table.

Highgate, N., April 18th, 1870.

ON

NITRIC ACID AND CHLORATE OF POTASSIUM

AS AN

OXIDISING MIXTURE APPLICABLE TO SULPHUR, SULPHIDES, CHROMIUM, ARSENIC, ORGANIC MATTERS, &C.

BY FRANK H. STORER,

PROFESSOR OF GENERAL AND INDUSTRIAL CHEMISTRY IN THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

SOME years since, while studying the action of various oxidising agents upon oxide of chromium, I was struck by the superior oxidising power of a mixture of ordinary nitric acid and chlorate of potassium over that of the mixtures of chlorate of potassium and chlorhydric or sulphuric acid commonly used in analysis. Inasmuch as the fact of the great oxidising power of a mixture of nitric acid and the chlorate had already been noticed and explained by several observers,* I at that time contented myself with a simple statement of my own observations of the action of the mixture upon chromic oxide,† without referring in any way to the general value of the mixture as an oxidising agent. Since that time, however, I have had frequent occasion to employ the mixture for effecting the oxidation of many substances besides oxide of chromium, such as present themselves in the ordinary experience of an analytical laboratory, and have satisfied myself that the merit of the process has not hitherto been duly appreciated.

Experience has convinced me, not only that a mixture of nitric acid and chlorate of potassium oxidises more rapidly than the common mixture of chlorhydric acid and chlorate of potassium, but that it is really to be preferred, in the great majority of cases, to any of the agents ordinarily employed to effect oxidation in the wet way. Instead of occupying, as now, a secondary or alternative place in the treatises on analysis, it ought to take precedence of the other processes of oxidation. It may be used with advantage in many instances where dry methods of oxidation are now recommended. With the exception, perhaps, of the sulphides or other compounds of antimony and tin, there are probably but few cases where its use will be found inadmissible.

The following notes include the results of several researches made by students of the Massachusetts Institute of Technology with the view of testing the capabilities of the process:—

Estimation of Sulphur in Organic Compounds. By A. H. Pearson.

It is easy to determine sulphur in non-volatile organic compounds, by oxidising the substance with chlorate of potassium and nitric acid, precipitating the sulphuric acid as sulphate of barium, and washing the latter with a solution of acetate of ammonium, to remove any nitrate of barium which may have adhered to it.

To oxidise the sulphur compound, place a weighed quantity of it in a porcelain dish, pour upon it three or four table-spoonfuls of strong nitric acid (39° B.), free from sulphuric acid, and add to the acid half a tea-spoonful of chlorate of potassium. Cover the mixture with an inverted glass funnel, the stem of which has been bent to a right angle. Place the dish on a wire-gauze support, and heat its contents. From time to time, lift the funnel slightly, and throw a small fragment of chlorate of potassium into the hot acid.

The funnel must be of such size that its rim may fall within the rim of the dish, and rest securely upon the sides of the dish, above the liquid. It serves to retain the particles of liquid which are thrown up from the dish by the gas evolved during the decomposition of the chlorate.

The oxidation will be completed more or less rapidly, according to the character of the substance operated upon. Only five or ten minutes are required to completely oxidise a third of a gramme of sulphocyanide of

* Compare Gmelin's "Handbook of Chemistry," vol. iii., p. 61.

† *Proceedings of the American Academy*, 1859, vol. iv., p. 342; *Journal für Praktische Chemie*, vol. lxxx., p. 44.

potassium, while from half to three-quarters of an hour are needed to destroy the same weight of ordinary free sulphur. It may be observed, in passing, that sulphur which has just been distilled dissolves twice as rapidly in a mixture of nitric acid and chlorate of potassium as sulphur which has long been exposed to the air.

Several samples of sulphocyanide of potassium, oxidised in this way, gave the following results:—

A. 0·2015 grm. of the sulphocyanide gave 0·5114 grm. of sulphate of barium. (I.)
A. 0·265 grm. of the sulphocyanide gave 0·6547 grm. of sulphate of barium. (II.)
B. 0·149 grm. of the sulphocyanide gave 0·3796 grm. of sulphate of barium. (I.)
B. 0·012 grm. of the sulphocyanide gave 0·03 grm. of sulphate of barium. (II.)
C. 0·101 grm. of the sulphocyanide gave 0·2387 grm. of sulphate of barium.
D. 0·028 grm. of the sulphocyanide gave 0·067 grm. of sulphate of barium. (I.)
D. 0·084 grm. of sulphocyanide gave 0·204 grm. of sulphate of barium. (II.)

The sulphocyanide used for the experiments mentioned in the paragraphs marked "A" was prepared by fusing together ferrocyanide of potassium, carbonate of potassium, and sulphur, in the usual way, treating the fused mass with hot alchohol, and allowing the alcoholic solution to crystallise. That used for the experiments in paragraphs B was prepared in precisely the same way as the foregoing, but at another time. The salt prepared in this way is evidently contaminated with free sulphur, or some sulphur compound other than the sulphocyanide which has been taken up by the alcohol.

The experiment recorded in paragraph C was made with crystals which separated from the alcoholic mother-liquid of B.

The experiments marked D were made with purified crystals, obtained as follows:—A quantity of the crude alcoholic crystals, similar to those used in experiments B, was dissolved in water; the solution was filtered to separate sulphur, and placed under a bell glass, over strong sulphuric acid, to crystallise. The crystals thus obtained were re-dissolved in alcohol, the solution filtered to separate carbonate of potassium, then concentrated by evaporation, and made to crystallise. The crystals were quickly pressed between folds of filter-paper, and portions of them were weighed out for the analyses.

The crystals obtained directly from the aqueous solution of the sulphocyanide were contaminated to a considerable extent with carbonate of potassium; but, after they had been re-crystallised from alcohol, only traces of the carbonate were found upon them.

Stated in terms of per cents, the results may be tabulated as follows:—

		Found. I.	Found. II.	Theory.
A.	Impure crystals	34·85	33·91	
B.	Impure crystals	34·98	34·33	
C.		32·45	—	32·90
D.		32·85	32·86	32·90

I have applied the foregoing method, not only to sulphocyanide of potassium and to free sulphur, as above described, but also for estimating sulphur in vulcanised caoutchouc, and in several samples of anthracite and bituminous coal. It is easy to completely oxidise either of these substances by means of the mixed chlorate of potassium and nitric acid. Anthracite dissolves even more readily than bituminous coal, since, unlike the latter, it does not fuse to a single mass in the hot acid.

It is not improbable that, by a slight variation of the foregoing process, it may be found practicable to determine the carbon of an organic compound at the same time as the sulphur. Thus, the oxidation might, perhaps, be effected in a flask, provided with a wide funnel-tube for the addition of the chlorate, and a delivery-tube through which the carbonic acid formed could be led into baryta-water or some other substance fit to absorb that gas. Upon this point, however, I have as yet made no experiments.

May, 1869.

Assay of Sulphur in Iron Pyrites. By A. H. Pearson.

The proportion of sulphur in iron pyrites ("sulphur-ore") may be readily and accurately estimated as follows:—Weigh out 1 grm. or less of the powdered ore, place the powder in a porcelain dish, together with a small quantity of chlorate of potassium, pour upon it some 50 c c. of pure nitric acid of 39° B., and cover the mixture with an inverted glass funnel with bent stem. Set the dish upon a water-bath, and heat the water to boiling. From time to time throw crystals of chlorate of potassium into the hot acid. By adding rather large crystals of the chlorate at frequent intervals, it is easy to oxidise the whole of the sulphide in half an hour; but, since the solution obtained in that case is highly charged with saline matter, it will usually be found more advantageous to use less of the chlorate of potassium, and to allow a somewhat longer time for the process of oxidation.

When all the sulphur has been oxidised, rinse the funnel with water, and remove it from the dish. Evaporate the liquid to a small bulk, then add to it a little concentrated chlorhydric acid, and again evaporate to absolute dryness, in order to render silicic acid insoluble. Moisten the residue with concentrated chlorhydric acid, mix it with water, and filter to separate silicic acid and gangue.

To the filtrate from the silicic acid add a quantity of solid tartaric acid, about as large as that of the pyrites originally taken; heat the liquid almost to boiling, and add to it an excess of chloride of barium, to precipitate the sulphuric acid. After the sulphate of barium has been allowed to subside, wash it thoroughly by decantation, first with hot water, and afterward with a dilute solution of acetate of ammonium; the latter may be prepared at the moment of use, by mixing ammonia-water and acetic acid. The purpose of the acetate of ammonium is to dissolve any nitrate of barium which may adhere to the sulphate; that of the tartaric acid is to prevent the precipitation of iron compounds together with the sulphate of barium. In an experiment where 0·7 grm. of pyrites was oxidised with chlorate of potassium and nitric acid, and the filtrate from silica was acidulated with chlorhydric acid without the addition of tartaric acid, there was thrown down, on the addition of chloride of barium, a bright yellow precipitate, which became darker-coloured when the solution was boiled. It was not only found to be impossible to wash out the iron with which this precipitate was contaminated, but the consistency of the precipitate was such that it was a difficult matter even to wash away the saline liquor in which the precipitate was formed.

In another experiment, the attempt was made to remove the iron from the filtrate from silica, before adding the barium-salt to throw down the sulphuric acid; but in that case a considerable portion of the sulphuric

acid was dragged down as sulphate of potassium by the iron precipitate, and so lost. The precipitation of the iron was effected, in this experiment, by adding an excess of ammonia-water to the acidulated filtrate from silica, and washing the precipitate for a long time by decantation with boiling water. To prove that the iron precipitate really retained sulphuric acid, a quantity of the precipitate was dried, ignited, and powdered, and the powder boiled with water. The clear liquid thus obtained was acidulated with chlorhydric acid, and tested with chloride of barium. An abundant precipitate of sulphate of barium was at once thrown down.

After the sulphur of the pyrites has been determined by precipitating it from a tartaric-acid solution, as above described, the iron might perhaps be estimated in the filtrate, by one of the new methods of titration with hyposulphite of sodium. I have made no experiments with the hyposulphite, but have failed completely in several attempts to determine the iron as a sulphide by precipitating with sulphide of sodium, as directed by Fresenius. I found it impossible to wash the sticky, slimy mass of sulphide of iron. It is not easy, on the other hand, to destroy the tartaric acid by igniting the dried filtrate from sulphate of barium in a muffle; for, on evaporating this solution, the saline matters with which it is charged continually creep over the edges of the dish.

November, 1868.

Assay of Copper Pyrites. By F. P. Pearson.

The following method of treating copper pyrites has been found more advantageous than the ordinary process of oxidising the mineral with aqua regia, and subsequently evaporating the solution repeatedly with chlorhydric acid, or with sulphuric acid, to expel the last traces of nitric acid:—

Place a weighed quantity of the powdered mineral, together with some chlorate of potassium, in a porcelain dish. (Five grms. of a variety of pyrites containing about 18 per cent of copper was found to be enough for one analysis; and a quantity of chlorate of potassium equal to a small tea-spoonful was added to the ore). Invert a small glass funnel with bent stem in the dish above the pyrites, and pour upon the latter rather more ordinary strong nitric acid than would be sufficient to completely cover the powder. Place the dish upon a water-bath, and, from time to time, throw into it small quantities of chlorate of potassium. The doses of the chlorate must be repeated at frequent intervals, until free sulphur can no longer be seen in the dish. If need be, add nitric acid, also, from time to time, to replace that lost by evaporation.

As a general rule, it is safer and more convenient to heat the mixture on a water-bath than upon sand, though I find that the oxidation of sulphur can be effected more easily and quickly when the mixture of nitric acid and chlorate is heated to actual boiling than at the temperature obtainable by means of a water-bath. When the last particles of sulphur have been destroyed, remove the inverted funnel from the dish, rinse it with water, and collect the rinsings in a beaker by themselves. Allow the liquid in the evaporating-dish to become cold, pour upon it a quantity of ordinary strong chlorhydric acid rather larger than the quantity of nitric acid taken at first, evaporate the mixed solution to dryness, and heat the dry residue to render silica insoluble, in case any silica be present.

Pour water upon the cold residue, and, without filtering the liquor, wash the contents of the dish into the beaker which contains the rinsings of the funnel. Heat the liquid in the beaker nearly to boiling, add to it about 25 c.c. of a strong aqueous solution of ferrous sulphate slightly acidulated with sulphuric acid, and keep the mixture at a temperature near boiling during four or five minutes, in order to destroy the small quantity of nitric acid which has escaped decomposition in spite of the evaporation with chlorhydric acid.

The ferrous salt seldom or never acts instantaneously, but the reducing-action proceeds rapidly and perfectly satisfactorily when once begun. If need be, add more of the ferrous solution, little by little, until the entire contents of the beaker become dark-coloured or almost black and no more gas is disengaged.

In order to be sure that all the nitric acid has been reduced, it is well enough, after the mixture of liquid and solution of ferrous sulphate has been duly heated, to place a drop of the mixture upon porcelain, and test it with ferricyanide of potassium. In general, however, the colouration of the liquor in the beaker, due to the formation of nitrous or hyponitric acid, will be a sufficient indication that the copperas has done its work. The nitrous fumes quickly disappear from the liquid at a subsequent stage of operations when metallic iron is immersed in the solution.

When enough of the ferrous sulphate has been added, filter the mixed solution into a wide beaker, precipitate the copper, in the metallic state, upon a sheet of iron in the usual way, and ignite the copper, in a porcelain crucible, in a current of hydrogen, before weighing it.

By means of the ferrous salt, the last traces of nitric acid may be got rid of far more quickly, conveniently, and certainly, than by the old system of evaporating the pyrites-solution with several successive portions of chlorhydric acid. By treating the pyrites with chlorate of potassium and nitric acid, it is easy to oxidise and dissolve every particle of the sulphur in the mineral, so that no portion of the latter can escape decomposition by becoming enveloped in free sulphur. When aqua regia is used, on the other hand, or a mixture of chlorate of potassium and chlorhydric acid, a certain proportion of sulphur almost invariably remains undissolved, and might easily enclose portions of the mineral, so as to protect them from the solvent action of the acids.

The method of oxidation above described can manifestly be employed with advantage for dissolving many other sulphuretted ores besides copper pyrites.

January, 1869.

Estimation of Sulphur in Sulphide of Mercury. By E. W. Bowditch.

In order to contrast the action of the mixed nitric acid and chlorate of potassium with that of the mixture of chlorhydric acid and chlorate of potassium ordinarily employed by chemists as an oxidising agent, a series of comparative experiments were made upon commercial vermillion.

Eight portions of the vermillion were operated upon, in succession, as follows:—In each instance, about 0·5 or 0·6 grm. of the vermillion was placed in a small glass flask, set in an inclined position upon a wire-gauze support above a lamp. A quantity of nitric acid of 39° B., or of concentrated chlorhydric acid, as the case might be, was poured into the flask; a small quantity of chlorate of potassium was added, and the mixture heated. From time to time, small bits of chlorate of potassium were thrown into the flask, the contents of

which were maintained near the boiling-point until all the sulphur, or as much of it as possible, had dissolved.

In every instance where nitric acid was employed, the vermillion was, in a short time, oxidised and dissolved so completely that no trace of free sulphur could be seen in the liquor. But, when chlorhydric acid was used to decompose the chlorate, there remained, invariably, floating upon the liquid, one or more yellow globules of undissolved sulphur, varying in size from that of a pin's head to a flax-seed. These floating globules could not be destroyed by any practicable amounts of the chlorate and acid; in fact, it may be said to be impossible to destroy such globules with these reagents.

Whenever chlorhydric acid was used, therefore, to decompose the vermillion, the solution obtained had to be filtered, to separate the free sulphur, before the sulphuric acid in the solution could be precipitated as sulphate of barium. The presence of free sulphur is objectionable, not only because time is lost in collecting, washing, drying, and weighing it, but also on account of its liability to enclose and conceal particles of the substance to be analysed, which would be dissolved by the acid if the latter were able to act upon them. The determination of sulphur may thus be rendered incorrect by weighing the undissolved substances with the sulphur.

When nitric acid was used with the chlorate, it happened sometimes, when the proportion of nitric acid was small, that a considerable quantity of saline matter crystallised in the flask; it was found, however, that enough water to re-dissolve this precipitate might be added to the mixture, without impairing to any material extent the oxidising power of the chlorate subsequently added. The acid liquor resulting from the action of nitric acid and chlorate of potassium upon the vermillion was evaporated to dryness on a water-bath, and the residue treated with strong chlorhydric acid, in order to destroy most of the nitric acid before proceeding to precipitate the sulphuric acid with chloride of barium. Before adding the chlorhydric acid to the residue, the latter must be allowed to become perfectly cold, lest the mixture froth violently, and portions of it be thrown out of the flask. After the acid has once been added, however, the mixture may be heated gently without risk of loss.

No matter whether chlorhydric or nitric acid is employed with the chlorate, the solution must at last be largely diluted with water before adding the chloride of barium.

In my experiments, nothing but hot water was employed to wash the sulphate of barium. Naturally enough, it was more difficult to wash, in this way, the precipitates obtained from solutions contaminated with nitric acid than those from the solutions which contained only chlorhydric acid; but, in spite of this disadvantage, and of the long time required to wash out the last traces of nitrate of barium, I have always found that a sulphur determination made by the nitric-acid process requires much less time for its completion than one made by the old way with chlorhydric acid.

In a final trial, made expressly for the purpose of testing this point, the precise times consumed in making each experiment were carefully noted. Two portions of the vermillion were weighed out into flasks, and treated, one with chlorhydric acid and chlorate of potassium, and the other with nitric acid and the chlorate. The portion treated with chlorhydric acid weighed 0·5695 grm., and the other 0·519 grm. The flask containing the sample treated with chlorhydric acid was taken from the fire a few minutes before the last traces of sulphur in the nitric acid flask had been destroyed, and the separation of the undissolved sulphur was proceeded with as rapidly as possible; but, in the end, it was found that eleven hours and three-quarters were required to complete the determination of sulphur in the portion of vermillion treated with chlorhydric acid, while the estimation of sulphur in the other portion, treated with nitric acid, was finished in nine and a half hours. 14·32 per cent of sulphur was found in the portion treated with nitric acid, and 14·25 per cent in the portion treated with chlorhydric acid, instead the 13·79 per cent required by theory.

February, 1868.

Estimation of Chromium as Chromate of Barium. By A. H. Pearson.

As Professor Storer has shown,* chromic oxide is quickly changed to chromic acid when boiled with a mixture of concentrated nitric acid and chlorate of potassium. All the chromium in ½ grm. of hydrate of chromium, or of any of the ordinary chrome salts, can in this way be converted into chromic acid in a few moments; and even compounds as refractory as chrome-iron ore, or oxide of chromium which has been strongly ignited, can be oxidised in less time than would be required to complete their oxidation by the process of fusion ordinarily employed.

As will appear from the experiments which follow, the chromic acid thus formed in the wet way can be readily and accurately estimated in the form of chromate of barium, if care be taken to wash the precipitated chromate with acetate of ammonium, or some other saline solution in which chromate of barium is insoluble.

1. A quantity of anhydrous chromic oxide was prepared, by heating bichromate of potassium with an excess of strong chlorhydric acid until chlorine ceased to be evolved, saturating the acid liquor with ammonia-water, washing and drying the precipitated hydrate, and finally igniting it intensely in a platinum crucible over a blast-lamp.

0·102 grm. of this anhydrous oxide was placed in an evaporating-dish, together with a quantity of nitric acid and some chlorate of potassium, and covered with an inverted funnel with a bent stem. The acid was heated, and fragments of chlorate of potassium were added to it from time to time, until the chromic oxide had completely disappeared. This result was attained in the course of half an hour.

The acid solution was diluted with water, then neutralised with ammonia, and the ammoniacal solution in its turn treated with enough acetic acid to make it slightly acid. After the accidulated solution has become cold, a solution of chloride of barium was added to it in slight excess, and the mixture was left at rest for ten or twelve hours. The precipitated chromate of barium was washed by decantation with a cold solution of acetate of ammonium, then collected on a filter, rinsed with water, dried, heated in a crucible to expel the last traces of water and of the ammonium-salt, and weighed.

The amount of chromate of barium obtained in this experiment was equal to 0·336 grm., which is equivalent to 68·31 per cent of chromium, instead of 68·62 per cent as required by theory.

The precipitate of chromate of barium must be al-

* *Proceedings of the American Academy*, 1859, vol. iv., p. 342.

lowed to stand for some time before filtering, lest it pass through the pores of the filter, and render the filtrate cloudy.

The acetate of ammonium employed for washing serves to dissolve any nitrate of barium or chloride of barium which may have been precipitated with the chromate; it has the further advantage of dissolving less of the chromate of barium than pure water would.

2. A quantity of hydrate of chromium, precipitated from a solution of reduced bichromate of potassium, as in the previous experiment, was dried at 115°, and the proportion of water retained by the dried hydrate was determined once for all by ignition.

0·11 grm. of this dried hydrate, equal to 0·0688 of the anhydrous oxide, was then treated with nitric acid and chlorate of potassium, as in experiment 1. It was found that the oxidation was completed as soon as the acid became hot enough to decompose the chlorate. Less than five minutes were sufficient, in this instance, for the complete conversion of the chromium to chromic acid.

The chromate of barium obtained weighed 0·2286 grm., equivalent to 68·65 per cent of chromium in th oxide taken, instead of the theoretical 68·62 per cent.

3. 0·113 grm. of the dried hydrate, containing 0·0707 grm. of the anhydrous oxide of chromium, was mixed with a quantity of nitrate of magnesium (prepared by dissolving carbonate of magnesium in nitric acid), before the treatment with nitric acid and chlorate of potassium. 0·2346 grm. of chromate of barium was obtained; in other words, 68·60 per cent of chromium, instead of the 68·62 per cent required by theory.

4. 0·114 grm. of the dried hydrate of chromium, containing 0·0713 grm. of the anhydrous oxide, was mixed with nitrate of aluminum (prepared by dissolving hydrate of aluminum in nitric acid), before the treatment with chlorate of potassium. 0·2356 grm. of chromate of barium was obtained; that is to say, 68·31 per cent of chromium, instead of 68·62 per cent.

5. A small quantity of chrome-iron ore was ground to very fine powder, and treated, in a dish, with nitric acid and chlorate of potassium, as above described. At the end of half an hour, that portion of the ore which still remained undissolved was washed with water, dried, fused with a mixture of carbonate of sodium and nitrate of potassium, and the fused mass boiled with water; but the solution thus obtained gave no reaction for chromium when tested for that substance.

It appears, from the foregoing experiments, that chromium can be readily estimated in this way in presence of aluminum and magnesium. The process can doubtless be employed also for separating chromium from iron, cobalt, nickel, and zinc. As a matter of course, special care must always be taken to employ reagents which are absolutely free from any contamination of sulphuric acid.

April, 1869.

On the Use of Chromate of Barium in Quantitative Analysis. By R. H. Richards.

A sample of pure bichromate of potassium, examined simultaneously by three of the students in the Institute's laboratory, for the purpose of determining the percentage of chromium by precipitating that element in the form of chromate of barium, gave the following discordant results (the method of analysis was similar to that described below):—

Name of experimenter.	Grms. of $K_2O,2CrO_3$ taken.	Grms. of BaO,CrO_3 found.	Percentage of chromium.	
			Found.	Theory.
N. F. Merrill ...	0·516	0·8640	34·67	35·56
F. P. Pearson...	0·500	0·8788	36·38	"
C. E. Avery....	—	—	36·31	"
"	—	—	36·24	"

At the suggestion of Professor Storer, I have examined other portions of the same sample of bichromate of potassium, with the view of discovering, if possible, the sources of error which vitiated the foregoing analyses.

A quantity of the bichromate was heated until it fused, the cold mass powdered and several portions of it, weighing from one to two grms. each, were taken for analysis. Each of the weighed quantities of bichromate was dissolved in distilled water; the solution was heated nearly to boiling, and a lump of acetate of sodium twice the volume of the bichromate of potassium taken was thrown into the hot liquor. Acetic acid was then added to strongly acid reaction, and afterwards a solution of chloride of barium, with occasional stirring, until no more precipitate was formed on the further addition of chloride of barium and until the supernatant fluid became absolutely colourless. It is easy to hit this point in a hot solution but not so easy when the liquid is cold.

After the precipitate had been allowed to stand for some time, the clear liquid above it was decanted into a filter. The precipitate was then washed with cold water, first by decantation in the beaker and afterwards upon the filter. The filtrate proper, that is to say, the clear liquor decanted from the precipitate, was in every instance colourless. It gave a white residue when evaporated on platinum foil and no precipitate when tested with acetate of lead. But all the subsequent liquors obtained by decantation and washing came through the filter distinctly yellow-coloured. They gave yellow residues when evaporated upon foil and bright yellow precipitates when tested with acetate of lead. It was, consequently, no easy matter to determine when to stop washing. The precipitates were, in fact, put aside to dry as soon as there was any reason to suppose that the saline mother-liquor had all been washed out from them.

In the second of the following experiments the chromate of barium was weighed upon a tared filter, as was the case also in the experiments cited above, but in Nos. 1, 3, and 4, the dry precipitate was ignited gently in a porcelain crucible before weighing.

No. of the experiment.	Grms. of $KO,2CrO_3$ taken.	Grms. of BaO,CrO_3 found.	Percentage of chromium found.	Theory.
1.	1·0095	1·7301	35·47	35·56
2.	1·0175	1·8444	37·53	
3.	1·5456	2·7541	37·74	
4.	1·5020	2·5696	35·49	

Experiments 3 and 4 were carried out side by side, and every effort made to treat them exactly alike.

From the appearance and behaviour of the wash-water, as above described, it appears that chromate of barium is somewhat soluble in pure water, but is insoluble in tolerably strong saline solutions, even in the presence of acetic acid. This observation agrees in the main with a statement* in Professor Storer's "Dictionary of Solubilities" to the effect that "chromate of baryta is very slighly soluble in water, and even insoluble when other salts are present in solution."

* Cited from Dumas's Traité de Chemie appliquée aux Arts.

On the other hand, the excess of precipitate found in experiments 2 and 3, would go to show that chloride of barium is liable to be dragged down by chromate of barium in the same way that it is apt to go down with sulphate of barium. It would appear, therefore, that some saline solution, competent to dissolve chloride and nitrate of barium, should be used instead of water for washing chromate of barium. [P.S.—In accordance with this view Mr. A. H. Pearson has recently employed a solution of acetate of ammonium, with the best results, for washing both the chromate and the sulphate of barium.]—*American Journal of Science*, vol. xlviii., No. 143.

REPORTS OF SOCIETIES.

GLASGOW PHILOSOPHICAL SOCIETY.

(Chemical Section.)

Ordinary Meeting, March 14, 1870.

Mr. Alexander Whitelaw, *Vice-President, in the Chair.*

Mr. W. R. Hutton read a paper on "*Canadian Phosphate of Lime, and some other Mineral Phosphates now Used in Making Superphosphate of Lime.*" The author mentioned that many mineral compounds having different characteristics both in physical appearance and in chemical compounds, as well as in results when operated upon, are now used in the manufacture of artificial manures, and referred to the fact that agriculturists are annually making greater demands upon the manufacturers of superphosphate of lime. He stated that, in general terms, the value of a mineral phosphate depends upon the percentage of phosphoric acid contained in it, but if there is any marked quantity of carbonate of lime present, the value of the phosphoric acid is much reduced, owing chiefly to the large quantity of sulphuric acid required to decompose the carbonate of lime before the phosphate can be reduced. The same remark holds true with reference to phosphatic minerals containing iron compounds in combination; the iron takes up its own equivalent of sulphuric acid, and as it is peroxidised a compound is formed which is positively injurious to plant life. Fluoride of calcium is also invariably found in phosphatic minerals, and it, too, requires sulphuric acid, thus increasing the cost of the superphosphate formed, while the gaseous fluorine compounds set free are a source of annoyance. No mineral phosphate has been so extensively employed as coprolites, and none is so little understood and valued by agriculturists. Although agriculturists, and even some manufacturers of manures, are inclined to look suspiciously upon the superphosphate of lime made from coprolites, Mr. Hutton said that his experience went to prove that superphosphate of lime is always of the same chemical value as a manurial agent, no matter what source it is obtained from. After referring to the origin and nature of coprolites, and the extent of the deposits in Cambridgeshire, Bedfordshire, and Suffolk, from which upwards of 200,000 tons are annually raised, the author proceeded to speak of the necessity for additional sources of mineral phosphates being resorted to, and new deposits being brought within the reach of manufacturers of manures, even if brought from other countries. He spoke of the German and Spanish phosphates as being very extensively had recourse to, although not so valuable as the English coprolites. Reference was made to a large and valuable deposit which occurs in South Carolina, and which has recently been brought into notice. Mr. Hutton mentioned that he was supplied some months since with specimens of phosphate of lime from Canada, obtained from a face of the material nearly fifteen feet in width, and presenting, so far as yet examined, an excellent supply of the raw material. The samples differ very much from those phosphatic minerals which are now in use, and seem to indicate that if a sufficiency can be obtained the Canadian mineral will be welcomed by manure manufacturers. Some of the specimens sent were distinct six-sided prismatic crystals, while the other pieces were in masses; but both crystals and masses had a vitreous lustre, the colour on some parts being green and bluish-green, and in other places red. The following analyses were given:—

	Masses.	Crystals.
Phosphate of lime	86·61	90·82
Fluoride of calcium	7·22	5·70
Chloride of calcium	0·06	0·14
Carbonate of lime	4·47	0·38
Moisture	0·08	0·32
Sand	0·10	0·10
	98·54	97·46
Oxide of iron		0·40
		97·86
Specific gravity	3·142	3·166

In a physical point of view this Canadian phosphate differs from all others in being crystalline and not granular; while it differs chemically in containing more phosphate of lime and less carbonate of lime and sand.

A short discussion followed the reading of the paper.

Mr. James Mahony afterwards read a paper entitled "*A Note on Plate Sulphate of Potash.*" This compound is obtained as a product from kelp, either by direct crystallisation from the lyes, or by solution and crystallisation of the granulate sulphate which is precipitated in the process of boiling down the liquors. When the liquor is about 42 to 44 of Twaddell, it is run into coolers, and in a day or two crystals are formed. The liquor is again saturated with soft sulphate, and a second crop of crystals is obtained on the first, and so on till a cake of sufficient thickness is produced. This salt is really a double sulphate, a fact first noticed by the late Dr. Penny; but the author of the paper finds that in practice the salt never contains more than from 73 to 75 per cent of the potassic sulphate instead of 78·56, as would be the case if the salts were present in the proportion of three of potassic to one of sodic sulphate. The plates enclose, during the time of their formation, small portions of the mother liquor which, becoming crystallised, account for the presence of chlorides and other salts, and thus diminish the percentage of potash. The well-defined crystals on the surface of the plates are almost pure. One of them examined by the author gave 77·60 per cent of sulphate of potash. Being clearly a double salt, the author said it might be expected that its solution and re-crystallisation would only have the effect of yielding a purer and more typical double sulphate. But this is not the case, for its component salts then become separated from each other in the order of their respective solubilities. Mr. Mahony proved this by operating upon five pounds of ordinary plate sulphate of potash, roughly pounding and dissolving in a sufficiency of boiling water. The insoluble matter was allowed to settle and was separated by a calico filter. The whole of the solution at 25° of Twaddell, was boiled down to 38°, when a pellicle formed on the surface. On analysis the first crystals gave—

$KOSO_3$	86·23
$NaOSO_3$	13·83
	100·06

There was not a trace of chlorine. The salt deposited at the bottom gave—

$KOSO_3$	84·26
$NaOSO_3$	15·66
	99·92

The pellicle of crystals on the surface gave $KOSO_3$ 81·16.

After removal of the first crop the mother-liquor was again boiled down to 38° Twaddell, and a second crop of crystals similar in appearance to the first gave—

Crystals	82·09	$KOSO_3$
Bottom	77·65	"

The operation of boiling down and crystallising was performed six times. In the fifth crop there was a layer of sulphate of potash with large, well-defined crystals of sulphate of soda on the top; and the sixth crop was chiefly sulphate of soda. The total quantity of salt removed was 4 lbs. 13 ozs., containing 3 lbs. 10·36 ozs. of pure sulphate of potash, the insoluble and loss amounting to 3 ozs. Sulphate of soda, being the more soluble salt of the two, was thus shown to remain in the liquor to the last, and, therefore, plate sulphate of potash cannot be classed in the category of ordinary double salts which remain of similar composition on re-crystallisation. In conclusion, the author referred at some length to the phenomenon of phosphorescence observed in the course of the process of crystallisation. He said it was affected by climatal influences, being more brilliant on some nights than others, and thus it might be assumed to be due to the electrical condition of the atmosphere.

A short discussion followed, in the course of which it was suggested that as Mr. Mahony was as accomplished as a naturalist as he was skilled as a chemist, he should give the section a paper on the phenomenon of phosphorescence as illustrated both by crystallising minerals and by the sea.

Votes of thanks were awarded to the authors of both papers.

Ordinary Meeting, March 28th, 1870.

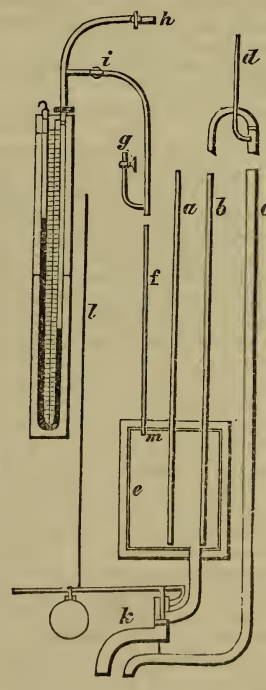
Mr. E. C. C. Stanford, F.C.S., Vice-President, in the Chair.

Mr. T. L. Patterson read two papers. The first was entitled—"*On a Method for Obtaining a Continuous Current of Air or Gas under Pressure, for Blowpipe and other purposes.*"

The author first explained how a continuous current of air or gas is obtained under ordinary circumstances, by the mouth blowpipe or the foot-bellows, and then mentioned the chief objections to those two methods, and proceeded to describe a method which he had found to be free from those objections. He said that it was well adapted to blowpipe work, and that he could easily obtain a pressure equal to half an atmosphere by means of it. The principle involved is the same as the Catalan blowpipe of Sprengel, and is wrought in connection with a Bunsen filter-pump, although it may be erected separately. The air-tap of a Bunsen pump being opened, the water is turned on, and air passes with the water down a long pipe, of 30 to 35 feet, in a continuous stream of bubbles. By receiving the stream into a bottle or other vessel, made air-tight with a cork through which two tubes are passed, one nearly to the bottom of the vessel and the other just through the cork, the water will flow off by the deep tube, and air escape by the upper; and, by placing a stopcock on the upper tube, to regulate the escape of the air, the pressure in the vessel may be made equal to the height of the water-tube. The apparatus, as used by Mr. Patterson, is made of sheet-lead and "compo" pipes. Its arrangement is shown in the accompanying sketch. The internal diameter of the water-pipes is ½ inch, and of the air-pipes ¼ inch.

At *a* is shown the exhaust-pipe of the pump; it reaches to within ¼ of an inch of the bottom of the leaden vessel, *e*, which is 9 inches square and 1 foot high. This vessel, or *accumulator*, is enclosed in a wooden box, by which its sides are supported. Two holes are pierced through the top, at opposite corners, and through one the water-pipe, *b*, passes to within ¼ of an inch of the bottom, and made air-tight. It is carried up alongside of the exhaust-pipe as high as is necessary for the desired pressure, and then bent back, and soldered into a 1-inch pipe, *c*, which returns, and carries the overflow-water from the pressure-pipe, *b*, to the sewer. At *d* is shown a short piece of ½-inch pipe, fixed into the waste-pipe, *c*, so that the latter may not act as a syphon. Into the other hole in the leaden vessel, *e*, a piece of ¼-inch pipe, *f*, long enough to reach to the laboratory, is soldered air-tight. One or more communications, as at *g*, may be taken off the pipe *f* to convenient places in the laboratory, and the pipe itself is continued to the same manometer as is used to show the vacuum obtained by the pump. Just before the vacuum and pressure pipes unite, however, there is a cock soldered into each, so that, when the pump is working, the vacuum-cock, *h*, is open and the pressure-cock, *i*, is shut—the reverse being the case when the pressure apparatus is required. The mercury in the manometer gives the vacuum or pressure in m.m.

Beneath the vessel, *e*, is placed a lever stopcock, *k*, of 1 inch diameter, to give free exit to the water while the pump is working for a full vacuum. This cock is wrought by means of wires, *l*, and pulleys, and thus, when the water is in the laboratory, the whole apparatus is under the operator's control. The mode of operating is as follows:—The lever-cock below the accumulator is opened, the vacuum and pressure cocks adjusted, and the water is turned on; and then the mercury in the near limb of the U-tube rises, and indicates a vacuum. But, when pressure is wanted (as for a blowpipe), the lever-cock is closed, the air-pipe of the



pump gently opened, the manometer gently adjusted, and, when the mercury is at the greatest height, the air is turned on to the blowpipe by the stopcock, *g*, and then the flame will continue regular, and as long as water and air flow down the exhaust-tube. The adjustment for the flow of water is the same for the pressure as for the vacuum apparatus.

This arrangement is suitable for conducting experiments under pressure, when that is not to be greater than half an atmosphere or so. In Mr. Patterson's apparatus, the pipe only rises to a height of 13¼ feet, equal to a column of mercury 303·6 m.m., or 11·95 inches. The author had no doubt that the apparatus would work well up to nearly half an atmosphere, and probably more, if the tubes could be indefinitely lengthened, as the quantity of air delivered by the ap-

paratus in a given time varies with the difference between the lengths of the exhaust and pressure pipes. A liquid may be boiled under the constant pressure of the apparatus by placing it in a strong flask, and connecting the latter (air-tight), by means of a flexible tube, with the pressure stopcock; or it may be distilled by connecting the receiver (made air-tight to the retort or distilling-vessel) with the pressure stopcock, as before. It will also be found useful for increasing filtration, by applying the pressure on the surface of the liquid to be filtered, when it is not desirable to use, or convenient to obtain, suction from beneath. Probably the most useful application of this air-current is to the blowpipe. With a Herapath lamp, it is easy, by means of the stopcocks, to obtain a small oxidising or reducing flame suitable for chemical experiments, or the strong and powerful jet for glass-blowing and crucible operations.

The author had not tried the apparatus with a Griffin's blast gas-burner; but, from calculations made, he had no doubt that, with a Herapath lamp, he could get a blast quite as strong as that obtained by using the Griffin lamp. He stated that it would be desirable to have a float-valve at the mouth of the air-pipe, *m*, in the accumulator, to prevent the access of water into it, in the event of the apparatus at any time becoming deranged or overtaxed. In conclusion, the author explained how the apparatus might be used for delivering a steady current of any other gas not very soluble in water.

The cost of Mr. Patterson's apparatus, as fitted in connection with a Bunsen pump, is about 30s.

A discussion followed. Several members expressed themselves much interested in, and pleased with, the apparatus, as described by Mr. Patterson.

The other paper read by Mr. Patterson was, "*On an Explosive Balloon.*"

The author gave an account of some efforts which he made some years ago to fire explosive balloons on their ascent. At first he tried the india-rubber balloons of the toy-shops. From various causes, they had failed; but the chief difficulty was doubtless the tension, which made it difficult to secure the gases. Recently the author's attention had been directed to the collodion balloons, obtainable of the philosophical-instrument makers, believing that they would suit well, both on account of their lightness, and on account of the fact that they would wholly disappear on ignition. After a number of trials, he had found them to succeed admirably. The method adopted was as follows:—A fuse of filter-paper, about 1 inch long and ½ an inch broad, is gummed to the side of the balloon, near the mouth, and allowed to dry. The latter is then filled with a mixture of 2½ volumes of hydrogen gas and 1 volume of oxygen, the mixture being prepared in a separate vessel. The mouth of the balloon is at once tied with a piece of thread, to increase the force of the explosion. When the balloon is ready to ascend, a drop of the so-called "Greek fire" (that is, a solution of phosphorus in carbon disulphide) is placed upon the filter-paper; the thread is cut, and the balloon left to itself. In the course of half a minute or so, the explosion ensues. It is necessary to have an excess of hydrogen in the mixture, because exosmose takes place so rapidly that, by the time of ignition, the volume of that gas is sensibly reduced.

The author mentioned that, in the course of his experiments with collodion balloons, he had found a very sensible amount of heat generated in the collodion film. This he believed to be due to the oxidation of hydrogen in the pores of the collodion, somewhat similar to the action of spongy platinum or platinum-black on a mixture of the two gases.

CHEMICAL SOCIETY.

Anniversary Meeting, March 30th, 1870.

Dr. A. W. Williamson, F.R.S., &c., *President, in the Chair.*

The following Officers have been elected for the ensuing year:—

President—A. W. Williamson, Ph.D., F.R.S.

Vice-Presidents who have filled the office of President—Sir B. C. Brodie, F.R.S.; Warren De la Rue, Ph.D., F.R.S.; A. W. Hofmann, D.C.L., F.R.S.; W. A. Miller, M.D., D.C.L., F.R.S.; Lyon Playfair, Ph.D., C.B., F.R.S.; Col. P. Yorke, F.R.S.

Vice-Presidents—J. H. Gilbert, Ph.D., F.R.S.; E. Frankland, Ph.D., F.R.S.; A. Mattheissen, Ph.D., F.R.S.; H. M. Noad, Ph.D., F.R.S.; W. Odling, M.B., F.R.S.; T. Redwood, Ph.D.

Secretaries—A. Vernon Harcourt, M.A., F.R.S.; W. H. Perkin, F.R.S.

Foreign Secretary—H. Müller, Ph.D., F.R.S.

Treasurer—F. A. Abel, F.R.S.

Ordinary Members of the Council—E. Atkinson, Ph.D.; H. Bassett; E. T. Chapman; F. Field, F.R.S.; David Forbes, F.R.S.; M. Holzmann, Ph.D.; E. J. Mills, D.Sc.; W. J. Russell, Ph.D.; Maxwell Simpson, Ph.D., F.R.S.; R. Angus Smith, Ph.D., F.R.S.; John Tyndall, LL.D., F.R.S.; A. Voelcker, Ph.D.

After having communicated to the Fellows the above list, the President delivered the following address:—

Gentlemen,—On behalf of the Council, I feel very great pleasure in congratulating you on the rapidly-increasing usefulness and prosperity of our Society.

The most interesting incident in the history of the past year has been the delivery by M. Dumas of the Inaugural Faraday lecture. It was indeed an impressive tribute to the memory of our great countryman which was paid by that noble veteran of science, and one of which the record ought to occupy a place of honour in our Journal. We still hope to receive from M. Dumas a manuscript of his classical discourse.

The Council have had the pleasure of accepting the offer of a munificent donation of palladium from Messrs. Johnson and Matthey, to be used for the preparation of the first ten Faraday medals.

Your Council have felt it to be of considerable importance to give greater publicity to the proceedings of the Society, and they have accordingly made provisional arrangements for the preparation of abstracts of the papers, and, in some cases, of the discussions, for transmission to such papers as desire to publish them. These abstracts already appear in several papers, and are read with interest

At the time of the last Anniversary Meeting, the Society numbered 522 Fellows. Since that time, 41 new Fellows have been elected, and have paid their admission-fees. On the other hand, six Fellows have been removed for non-payment of fees, one Member (Mr. A. W. Gillman) has withdrawn from the Society, and we have lost five by death. The present number of Fellows is accordingly 551.

The number of Foreign Members at the time of our last Anniversary Meeting was thirty-eight, but of these we have to deplore the death of two, viz., Dr. Otto Linné Erdmann, Leipzig, and Dr. Joseph Redtenbacher, Vienna; so that we now count only thirty-six Foreign Members.

The names of the Fellows who have died during the past year are:—Thomas Graham, Sept. 16th; T. Penny, Nov. 22nd; A. B. Northcote, Dec. 28th; E. N. Brayley, Feb.; and I have this morning received intelligence of the death of Julian Courtauld and T. L. Wheeler.

Thomas Graham died September 16th, at his house, 4, Gordon Square.

From an early age, Graham's one great object of life was the discovery of new truths, and he appreciated so fully the value of such work that he resolved to make any personal sacrifices which might be needed for its sake. And nobly he kept his resolution; for, at an early stage of his career, he endured, for the sake of pursuing chemistry, privations and sufferings so severe that they are believed to have permanently injured his constitution; and, at its very end, long after he had attained a world-wide reputation, when his delicate frame sorely needed the repose which was at his command, he continued to labour even more effectively than before, and to enrich science with new discoveries.

It might be difficult to find in history a character so perfect in its noble simplicity and elevation.

Graham was born at Glasgow, on December 21st, 1805, the eldest of a family of seven, of whom only one survives.

He went to the English Preparatory School at Glasgow in 1811, and was there under the care of Dr. Angus. In the year 1814, he was removed to the High School, where, for four years, his studies (which included the Latin language) were directed by Dr. Dymock, and subsequently for one year by the Rector, Dr. Chrystal, under whom he studied Greek. It is said that during these five years he was not once absent at school-time. In 1819, he commenced attendance in the University classes in Glasgow.

Thomas Thomson then occupied the Chair of Chemistry, and young Graham benefited by his instruction, as, also, by that of Dr. Meikleham, the Professor of Natural Philosophy.

By this time he had already acquired a strong taste for experimental science, and formed a wish to devote himself to chemistry. His father, an able and successful manufacturer, had formed different views for his future career, and wished him to become a minister of the Scotch Church. It is hardly to be wondered at that the father should not have seen in the prosecution of science much scope for an honourable or advantageous career; but young Graham had already seen something of the means afforded by experimental science of getting knowledge from the fountain-head—from Nature herself. He felt the need of more such knowledge to mankind, and his scheme of life was formed accordingly.

After taking the degree of M.A. at Glasgow, he continued his studies for two years at Edinburgh, and there studied under Dr. Hope, and enjoyed the friendship of Professor Leslie. On his return to Glasgow, he taught mathematics for some time, at the suggestion and under the patronage of Dr. Meikleham, and subsequently opened a laboratory, in Portland Street, Glasgow, where he taught chemistry. It is probable that some of the severest trials of his life occurred at about this period.

While absent from Glasgow, he was in the habit of writing regularly and at great length to his mother; and from the tenour of these letters, it is easy to see what that mother must have been to him. A writer on the social position of women has described the feelings of boys towards their mothers as scarcely amounting to respect! Young Graham's mother seems to have been his guardian-angel, sympathising with his hopes and his sorrows; and certainly his feelings towards her would have been very inadequately described by that frigid word. While studying at Edinburgh, he earned, for the first time in his life, some money, by literary work, and the whole sum (£6) was expended in presents to his mother and sisters.

In 1829, he was appointed Lecturer on Chemistry at the Mechanics' Institution, Glasgow, in place of Dr. Clarke; but the decisive step of his life was in the subsequent year. It was in 1830 that he was appointed Professor of Chemistry at the Andersonian University, Glasgow; and it is said that his mother, who was on her deathbed, lived to hear the glad tidings of his appointment. He was now more favourably circumstanced for experimental labours; and we find that the seven years spent at the Andersonian University were years of great activity.

In the beginning of the year 1837 died Edward Turner, Professor of Chemistry in the newly-founded London University, now called University College, London. Thomas Graham was the successful candidate for the vacant chair, and in August of the same year we find him already settled in the great metropolis. It was only now that the young philosopher found adequate scope for his abilities. Young men thirsting for knowledge crowded to his lectures, and in those lectures he explained the principles of chemical science with an exactness and clearness never before attained. The success of these lectures was not due to eloquence, nor to any smoothness of diction, for all such matters Graham usually neglected to a degree which in an ordinary person would hardly have been excused. He had a truly philosophical method, which carried away the listener with irresistible force,—the same exactness of thought, the same logical arrangement of matter—in a word, the same purely scientific mind which pervades his work, "The Elements of Chemistry." That work, which immediately made its author's name known in all parts of the world, is too well known to the Fellows of the Chemical Society for it to be necessary to speak here of its great merits. I will merely allude to the successive editions which have appeared in England, the numerous reprints scattered about America, and the translations published in many languages. In Germany, the excellent edition of Fr. Tul. Otto is still the most extensively used and the most valued book of chemical instruction.

Of Graham's investigations that on the phosphates is remarkable in many ways. It was known that solutions of phosphoric acid in water vary in their properties; and chemists were satisfied with giving a name to the changes without investigating their nature. These solutions contained phosphoric acid and water, and were assumed to have like composition. They were accordingly called isomeric. Graham observed that they differ from one another in the proportion of water combined with the acid, and constitute in reality different compounds.

He knew that water combines with acids as other bases do, and he showed that the various compounds of phosphoric acid and water constitute distinct salts, each of which admits of its hydrogen being replaced by other metals without disturbance of what we should now call the type. Thus, to use our present notation, the three hydrates PO_4H_3, $P_2O_7H_4$, PO_3H, correspond to the following proportions of acid and water:—

$$P_2O_5+3H_2O=2PO_4H_3$$
$$P_2O_5+2H_2O=P_2O_7H_4$$
$$P_2O_5+H_2O=2PO_3H$$

Graham observed that the hydrate PO_4H_3 is constituted like a salt, inasmuch as its hydrogen can be replaced, atom for atom, by other metals, like sodium, potassium, &c., forming such compounds as PO_4NaH_2, PO_4Na_2H, &c.

In order to appreciate duly the powers of mind of the author of this admirable research, we ought to compare his methods of reasoning with those generally prevalent among contemporary chemists, and, on the other hand, with the methods of to-day. One would fancy that Graham had been acquainted with the modern doctrines of types and of polybasic acids, so clearly does he describe the chemical changes in matter-of-fact language, and so consistently does he classify the compounds by their analogies. At that early period we find Graham considering hydrogen, in various salts, as a basylous metal; an idea which, in spite of its undeniable truth, some chemists of the present day have not fully realised.

Amongst minor chemical researches, may be mentioned a series of experiments on the slow oxidation of phosphorus by atmospheric air. He discovered that this process (and the faint light which accompanies it) is arrested by the presence in the air of a trace of olefiant gas, 1-450th of the volume of the air being sufficient for the purpose. Still smaller proportions of some other vapours were found capable of producing this same effect; spirits of turpentine being particularly remarkable, as less than a quarter of a thousandth of its vapour with air was found sufficient to prevent the slow oxidation of phosphorus.

On another occasion Graham investigated phosphuretted hydrogen, and made some remarkable observations concerning the conditions of the formation of the spontaneously inflammable gas. One of these deserves especial notice in connection with the action of olefiant gas, and in preventing the oxidation of phosphorus. He found that phosphuretted hydrogen is rendered spontaneously inflammable by the admixture of a very small proportion of an oxide of nitrogen, probably nitrous acid.

One of the most obscure classes of combinations are those which water forms with various salts. These bodies are characterised by the chief peculiarities which belong to definite chemical compounds; but chemists are, as yet, unable to explain them.

Water so combined is called water of crystallisation, and is said to be physically. not chemically, combined. A very convenient way of getting rid of a difficulty, by passing it on to our neighbours.

Graham examined the proportion of such water of crystallisation in a considerable number of salts, and he moreover examined the propertics which it has when so combined. He found that some of the water in an important class of sulphates is held far more firmly than the remainder, and with force equal to that with which water is held in various chemical compounds. He showed that such firmly combined water can be replaced by salts in a definite chemical proportion. In fact, he got fairly hold of the subject by chemical methods, and laid the foundation for an explanation of it.

He discovered and examined compounds of alcohol with salts, and derived from them valuable evidence of the analogy between alcohol and water.

On a later occasion he made a series of important experiments upon the transformation of alcohol into ether and water, by the action of hydric sulphate. Liebig had endeavoured to explain the formation of ether in this process, by representing it as due to the decomposition at a high temperature of a compound of ether previously formed at a lower temperature; such decomposition being due to the increased tension of the vapour of ether at the higher temperature.

Graham justly argued that if the decomposition were due to the tension of ether vapour, it would not take place, and ether would not be formed, if the tension were not allowed to exert itself. He heated the materials in a closed tube, and proved that ether was formed, although the tension of its vapour was counteracted by the pressure thus obtained.

The line of research which occupied most of his attention, and in which his results were, perhaps, the most important, was that of diffusion ; and it would be difficult to over-estimate the importance to molecular chemistry of his measurements of the relative velocities of these spontaneous motions of particles of matter, whether in the state of gas or in the liquid state.

It was known that one part by weight of hydrogen occupies the same volume as sixteen parts by weight of oxygen when measured at like temperature and under like pressure. Chemical investigations prove that these equal volumes of the two gases contain the same number of atoms. We also know that the atoms in such a gas are in rapid motion, and resist the pressure to which the gas is at any particular time exposed, by striking against the surface which presses them together with force equal to that which presses them together.

Thus a given volume of hydrogen is maintained against the atmospheric pressure by an energy of atomic motion, equal to that of the same volume of oxygen. Each atom of hydrogen accordingly exerts a mechanical energy equal to that of each atom of oxygen; but we have seen that the hydrogen atom is much lighter than the oxygen atom, and accordingly it must move with much greater velocity than the oxygen atom.

Now Graham allowed hydrogen to escape through a very small hole in a plate of platinum; and allowed oxygen to escape under similar circumstances. He found that each hydrogen atom moves out four times as fast as each oxygen atom. His experiments were so arranged as to enable him to measure the relative velocities of certain motions of the atoms—motions not imparted to them by any peculiar or unnatural conditions, but belonging to them of necessity in their natural state. He found, moreover, that heat increases the velocity of these atomic motions, whilst increasing the force with which a given weight of the gas resists the atmospheric pressure.

He remained at University College till the year 1855, when he was appointed Master of the Mint, an office which Sir John Herschel had recently resigned. His illustrious friend, Hofmann, from whom I have already freely quoted, shall tell how he discharged these responsible duties.

"It would be difficult to picture the extensive activity which Graham exercised in the high office entrusted to him. The new Master of the Mint showed a circumspection, a mastery of details, an amount of industry and energy, and when occasion required an impartial severity, which astonished every one—more especially some of the officials of the Mint. Such requirements had not hitherto been made, nor such control exercised. A strong resistance was made to the plans of innovation and alteration of the new Master." The author of these lines, Hofmann, at that time held an office in connection with the Mint, and was, therefore, witness of Graham's struggles in his new position. "It was years before he gained a complete victory, and before he was able to return to his favourite study. But at last this longed for period came, and a series of happy years followed. Not an instant was lost. A convenient laboratory was fitted up in the official residence of the Master of the Mint, whose handsome rooms the simple and independent man never occupied, and there his old labours were resumed with greater zeal than ever. Some of Graham's most beautiful researches date from this period. They sprang from the pure love of science. Graham needed to earn no name or position. Both had long been his undisputed property. But the same earnest desire to study nature which in early youth had induced him to bear without murmurs the greatest privations and the bitterest sorrows, still animated him and armed him against the new dangers which threatened his scientific labours from the splendour of his official position and the distractions which it entailed on him."

The study of the condensation of gases by solids, and the combination of soluble compounds with membranes, led him to discoveries which are likely to be of great value to physiologists in explaining processes of absorption and secretion.

Thus he found that oxygen is absorbed to a greater extent than nitrogen by caoutchouc, and that when a bag made of a thin membrane of this substance is exhausted by means of a good air-pump, the oxygen and nitrogen diffuse through it (probably as condensed liquids), and evaporate inside the bag in different proportions from those in which they are present in air; the oxygen rising to over 40 per cent of the diffused air. Again, a mixture of hydrogen and oxygen was separated almost completely by the action of palladium, which condensed the hydrogen in very large quantity, and the oxygen very slightly.

Perhaps the most remarkable substances discovered in the course of his experiments on diffusion were the soluble modifications of tungstic and molybdic acids, ferric oxide, &c., and the process by which these bodies were obtained was, perhaps, the most instructive part of the result; proving, as it does, that in their salts, these bodies have properties different from those which they normally possess in the free state; and retain them when the other constituent is removed by a sufficiently gentle process.

Another remarkable fact which bears on a most important theory, is the separation effected by Graham of potassic hydrate and hydric sulphate, by diffusion of potassic sulphate in aqueous solution—a fact which requires us to admit that the solution of the salt in water contains those products mixed with one another; just as much as the experiment of diffusing air through a porous clay pipe, and getting its constituent in a different proportion from that of the original air, proved that air is a mixture and not a compound of the two gases.

The phenomena of the diffusion of gases and liquids do not astonish us by their brilliancy and variety; but the im-

mense importance of this region of experimental science dawns upon us when we remember that there is no so-called vital process which cannot ultimately be referred to a chemical process, that more or less intense chemical action takes place at all points of the frame of animals and plants, and that an essential condition of this action, and of life itself, is the carrying to and fro of materials, not only by muscular and ciliary action, but in a more intimate measure by diffusion.

In many of his ideas Graham was in advance of his contemporaries, and it might be difficult to find a chemist who has dealt more cautiously with general questions and delicate experimental operations,—or one whose results, in each direction in which he has worked, may more safely be expected to stand the test of future investigations.

The proceedings of the meeting terminated with a vote of thanks to the President for the able and effective manner in which he had discharged his official duties during the past year.

April 7th, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

THE following gentlemen were elected Fellows:—F. Andrews, jun., W. Martindale, A. H. Palmer.

Dr. DIVERS concluded his paper "*On the Combinations of Carbonic Acid with Ammonia and Water.*"

This elaborate and very extensive memoir does not permit of any abbreviation. Readers desiring more information are therefore referred to the *Journal of the Chemical Society*, which will, in one of the next numbers, publish Dr. Divers's investigations.

Dr. GLADSTONE communicated a paper "*On the Refraction Equivalents of the Aromatic Hydrocarbons, and their Derivatives.*"

In a previous paper (read before the Society on March 3rd), it was shown that, having ascertained the refraction equivalents of carbon, hydrogen, oxygen, nitrogen, and chlorine, the refractive values of a large number of compounds, built up by those elements, may be calculated with a close approximation to the truth. In the present paper, Dr. Gladstone treats with the exceptions to that rule. Phenylic acid, oil of bitter almonds, salicylic acid, methylic salicylate, methylic benzoate, ethylic benzoate, benzol, toluol, xylol, cumol, cymol, carvol, eugenic acid, pyridine, chinoline, aniline, nitrobenzol, chlorobenzol, naphthalin, and many others yet, give, by experiment, much higher refractive values than by calculation. A glance at the names of these exceptional substances will show that they consist of the aromatic hydrocarbons, with the bodies derived from, or related to, them. The refraction equivalents of the hydrocarbons themselves, and their chlorine substitution products, are about 6·0 above what theory requires; the compounds from creosote are a little higher still. The azotised products, and those containing C_7, are very nearly 8·0 above the calculated values, and hydride of cynnamyl is well known to be among the most refractive and dispersive of bodies. To what can this increased refraction be attributed? Dr. Gladstone thought first that the hydrogen in benzol and its congeners or derivatives might have a refraction value of 3·5 as in the hydracids of the halogens. But on investigating chlorhydranil, $C_6Cl_4O_2H_2$, where the greater part of the hydrogen is replaced by chlorine, and where the existing hydrogen is considered not to belong to the nucleus, a refraction equivalent of 7·6, that is, about the usual amount above the theoretical value, was obtained. Dr. Gladstone is now disposed to regard the nucleus, phenyl, C_6H_5, as an entity, having an exceptionally great influence on the rays of light, and this augmentation of refractive power has its analogy to that change in the refraction value which certain elements (for instance, iron and phosphorus), undergo when they alter their atomicity. This entity is not destroyed by the replacement of its hydrogen by chlorine, nitric oxide, oxygen, or sulphur. When, however, this nucleus is subjected to such chemical change as to break it up, the resulting products have only the ordinary effect on light.

Taking the difference of the figures obtained by experiment, and of those by calculation, it is found that the group of essential oils give refractive values of about 2 higher than required by theory; the phenyl group about 6 above the theory; the naphthalin group about 14; and the anthracen group about 17 above the calculated figures. Now, in these groups, the carbon increases in proportion to the hydrogen, and thus it becomes probable to arrange the above substances into certain series, which Dr. Gladstone regards, however, as merely a rough sketch, and by no means as a decided question. He hopes, at some future time, to say more on this subject.

Mr. HUNTER, of Queen's College, Belfast, communicated a paper on "*Analysis of Deep Sea Water*," a sequel to a note read before the Society in December last.

Messrs. BOLAS and GLOVES read a note "*On the Convenient Preparation of Bromo-picrin.*" They also gave preliminary announcement of the discovery of tetra-bromide of carbon.

Professor HOW had sent a memoir "*On an Acid Feed Water from the Coal-Field at Stellarton, Nova Scotia.*" The paper is chiefly remarkable by giving information of the presence of free oil of vitriol in the water which is used for feeding boilers.

For the meeting on April 21st, a lecture "*On Vanadium*," by Professor ROSCOE, is announced.

April 21st, 1870.

Professor WILLIAMSON, F.R.S., President, in the Chair.

T. PATCHETT was elected a Fellow.

Professor ROSCOE, F.R.S., delivered a lecture "*On Vanadium.*"

This metal was discovered in 1830, by Sefström, in the celebrated Swedish bar-iron made from the Taberg ore. Sefström ascertained some of the most peculiar characters of this substance, proved it to be a new element, and prepared some of its compounds in the pure state. The reactions by which vanadium can be separated and distinguished from all the other elements are:—(1) The formation of a soluble sodium vanadate when the vanadium compounds are fused with sodium carbonate; (2) the formation of an insoluble ammonium vanadate when sal ammoniac is added to the solution of a soluble vanadate; (3) the production of a splendid blue solution when this ammonium salt, dissolved in hydrochloric acid, is warmed with reducing agents, such as oxalic acid.

Sefström, not having leisure to prosecute the full examination of the properties of the new metal, handed over his preparations to Berzelius; and it is to the investigations of the great Swede that we owe almost all our acquaintance with the chemistry of vanadium.

Since Berzelius's time, vanadium has been discovered in many minerals, of which a lead ore containing lead vanadate, and called by the mineralogists, vanadinite, is the most important.

In 1865, Professor Roscoe came into possession of a plentiful source of vanadium, in a by-product obtained in the preparation of cobalt from the copper-bearing beds of the lower Keuper Sandstone of the Trias, at Alderley Edge, in Cheshire. Following, in the main, the process of preparation adopted by Sefström, Professor Roscoe obtained, from the above-mentioned source, several pounds of pure ammonium vanadate, from which all the other compounds of vanadium can be prepared.

What, now, were the conclusions to which Berzelius arrived, from his experiments concerning the constitution of the vanadium compounds? He assigned to its three oxides the formulæ VO, VO_2, and VO_3, whilst the chloride was represented by VCl_3. The atomic weight of the metal he found to be V=68·5.

Some years afterwards, Rammelsberg observed that vanadinite, a double salt of lead-vanadate and lead chloride, is isomorphous with apatite and with mimitesite, the former containing phosphoric, the latter arsenic acid. This crystallographic analogy would lead us to conclude that the oxide of vanadium in the vanadinite has the formula V_2O_5, agreeing with the corresponding oxides of phosphorus and arsenic, P_2O_5 and As_2O_5; but the unyielding chemical facts of Berzelius compel us to view the oxide in question as VO_3. It was, then, evident that here was either an exception to the law of isomorphism, or else Berzelius's views were erroneous.

Professor Roscoe, in order to endeavour to clear up this question, had carefully repeated Berzelius's experiments, and he found them confirmed in every particular; but, having pursued the subject further than Berzelius, he had succeeded in obtaining the key to the enigma presented by the above anomalous crystallographic relations.

The lecturer has proved that the substance supposed by Berzelius to be vanadium is not the metal, but an oxide, and that the true atomic weight of the metal is 51·3. The vanadic acid, VO_3, of Berzelius, hence, becomes V_2O_5, corresponding to P_2O_5 and As_2O_5; and the above-mentioned isomorphism is fully explained. The sub-oxide of Berzelius is a tri-oxide, V_2O_3; whilst the terchloride (VCl_3) of Berzelius is an oxychloride, $VOCl_3$, corresponding to oxychloride of phosphorus, $POCl_3$.

Professor Roscoe has succeeded in obtaining bromine and iodine compounds of vanadium, and also various metallic vanadates. He went on with his lecture by pointing out that the characters of the vanadates bear out the analogy of the vanadic acid with the highest oxides of phosphorus and arsenic; and stated, in conclusion, that vanadium, hitherto standing in no definite relation to other elements, must now be regarded as a member of the well-known triad class of elementary substances, comprising nitrogen, phosphorus, boron, arsenic, antimony, and bismuth.

The President, in proposing a vote of thanks to the lecturer, called attention to the great service Professor Roscoe had rendered to chemical science by his successful investigation of vanadium.

After the delivery of this lecture, Professor Hofmann, from Berlin, favoured the Society with a few observations on an organic body he had obtained by treating sulpho-urea with silver oxide. This substance, CH_2N_2, is distinguished by its great tendency to polymerise.

Dr. Hofmann further communicated that a compound isomeric with chloral had recently been discovered by two Berlin chemists. It differs from ordinary chloral by its much higher boiling point.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, March 22nd, 1870.

E. W. Binney, F.R.S., F.G.S., Vice-President, in the Chair

The following extract of a letter, dated March 21st, 1870, from Sir W. Thomson, D.C.L., F.R.S., Hon. Member of the Society, to the President, was read:—

I have now, at last, got into good working-order measurements of electrostatic capacity (which, perhaps, you may remember I was working on the first time you ever came to see me, and more or less almost ever since). I have two students of last year, junior assistants in my laboratory, measuring electrostatic capacities of condensers, and variations of specific inductive capacities of resistance, with sensibility of 1–10th per cent, and with constancy, in spite of accidental variations, generally within $\frac{1}{2}$ or $\frac{1}{5}$ per cent.

My occupation on the kinetic theory of gases has led me, at last, to come to definite terms as to the size of molecules. Ever since about the first year of my Professorship, I have taught my students that Cauchy's theory of dispersion proves heterogeneousness, or molecular structure, to become sensible in contiguous portions of glass or water of dimensions moderately small in comparison with the wave-lengths of ordinary light. I have spoken to you also, I think, of the argument deducible from the contact-electricity of metals. This, I now find, proves a limit to the dimensions of the molecules in metals quite corresponding to that established for transparent solids and liquids by the dynamics of dispersion. In experiments made about ten years ago, of which a slight sketch is published in the *Proceedings of the Literary and Philosophical Society of Manchester*, I found that a plate of zinc and a plate of copper, kept in metallic connection with one another (by a fine wire or otherwise), act electrically upon electrified bodies in their neighbourhood, and upon one another, as they would if they were of the same metal and kept at a difference of potentials equal to about three-quarters of that produced by a single cell of Daniell's. Hence, and from my measurement of the electrostatic effects of a Daniell's battery, published in the *Proceedings of the Royal Society* for February and April, 1860, I find that plates of zinc and copper, held parallel to one another at any distance (D) apart which is a small fraction of the linear dimensions of their opposed surfaces, and kept in metallic communication with one another, exercise a mutual attraction equal to—

$$2 \times 10^{-10} \times \frac{A}{D^2} \text{ grms. weight.}$$

Hence, if they were allowed to approach from any greater distance (D′) to the distance D, the work done by their mutual attraction is—

$$2 \times 10^{-10} \times \frac{A(D'-D)}{D'D} \text{ centimetre grms.;}$$

which, if D is very small in comparison with D′, is very approximately equal to—

$$2 \times 10^{-10} \times \frac{A}{D}$$

Now, suppose a pile to be made of a great number (N+1) of very thin plates alternately of zinc and copper, kept in metallic connection while they are brought towards one another. Let their positions in the pile be parallel, with narrow spaces intervening. For simplicity, let the thickness of each metal plate and intervening space be D. The whole work done will be—

$$2 \times 10^{-10} \times N\frac{A}{D}$$

The whole mass of the pile, if we neglect that of one of the end plates, is $NAD\rho$, where ρ denotes the mean of the densities of zinc and copper. Hence, if h be the height to which the whole mass must be raised against a constant force equal to its weight at the earth's surface, to do the same amount of work, we have—

$$NAD\rho h = 2 \times 10^{-10} \times N\frac{A}{D}$$

which gives—

$$h = \frac{2 \times 10^{-10}}{\rho D^2}$$

or, as $\rho = 8$, nearly enough for the present rough estimate,

$$h = \frac{1}{(200000D)^2}.$$

Hence, if—

D = 1-200,000th centimetre,

h = 1 centimetre.

The amount of energy thus calculated is not so great as to afford any argument against the conclusion which general knowledge of divisibility, electric conductivity, and other properties of matter, indicates as probable—that, down to thicknesses of 1-200,000th of a centimetre for the metal plates and intervening spaces, the contact electrification, and the attraction due to it, follow with but little, if any, sensible deviation

he laws proved by experiment for plates of measurable hickness with measurable intervals between them. But, let) be 1-200,000,000th of a centimetre: if the preceding for-nulæ were applicable to plates and spaces of this degree of hinness, we should have—

h = 1,000,000 centimetres, or 10 kilometres.

The thermal equivalent of the work thus represented is about 248 times the quantity of heat required to warm the whole nass (composed of equal masses of zinc and copper) by 1° C. This is probably more than the whole heat of combination of equal masses of zinc and copper melted together; for it is not probable that the compound metal, when dissolved in an acid, would show anything approaching to so great a deficiency in the heat evolved below that evolved when the metallic constituents are separately dissolved,* and their solutions mixed. But the experiment should be made. Without any such experiment, however, we may safely say that the fourfold amount of energy indicated by the preceding formula for a value of D yet twice as small is very much greater than any estimate which our present knowledge allows us to accept for the heat of combination of zinc and copper. For something much less than the thermal equivalent of that amount of energy would melt the zinc and copper; and, therefore, if in combining they generated by their mutual attraction any such amount of energy, a mixture of zinc and copper filings would rush into combination (as the ingredients of gunpowder do) on being heated enough in any small part of the whole mass to melt together there. Hence we may infer that the electric attraction between metallically-connected plates of zinc and copper of only 1-400,000,000th of a centimetre thickness, at a distance of only 1-400,000,000th of a centimetre asunder, must be greatly less than that calculated from the magnitude of the force and the law of its variation observed for plates of measurable thickness, at measurable distances asunder. In other words, plates of zinc and copper, so thin as 1-400,000,000th of a centimetre, and placed at as short a distance as 1-400,000,000th of a centimetre from one another, form a mixture closely approaching to a molecular combination, if, indeed, plates so thin could be made without splitting atoms.

Wishing to avoid complication, I have avoided hitherto noticing one important question as to the energy concerned in the electric attraction of metallically-connected plates of zinc and copper. Is there not a change of temperature in molecularly-thin strata of the two metals adjoining to the opposed surfaces, when they are allowed to approach one another, analogous to the heat produced by the condensation of a gas, the changes of temperature produced by the application of stresses to elastic solids which you have investigated experimentally, and the cooling effect I have proved to be produced by drawing out a liquid film which I shall have to notice particularly below? Easy enough experiments on the contact-electricity of metals will answer this question. If the contact-difference diminishes as the temperature is raised, will follow from the second law of thermodynamics (by reasoning precisely corresponding with that which I applied to the liquid film in my letters to you of February 2nd and February 3rd, 1858 †) that plates of the two metals, kept in metallic communication and allowed to approach one another, will experience an elevation of temperature; but, the contact-difference increases with temperature, the effect of mutual approach will be a lowering of temperature. On the former supposition, the diminution of intrinsic energy in quantities of zinc and copper, consequent on mutual approach with temperature kept constant, will be greater, and, on the latter supposition, less than I have estimated above. Till the requisite experiments are made, further speculation on this subject is profitless; but, whatever be the result, it cannot invalidate the conclusion that a stratum of 1-200,000,000th of a centimetre thick cannot contain in its thickness many, if much as one, molecular constituent of the mass.

Besides the two reasons for limiting the smallness of atoms or molecules which I have now stated, two others are afforded by the theory of capillary attraction and Clausius's and Maxwell's magnificent working out of the kinetic theory of gases.

In my letters to you already referred to, I showed that the dynamic value of the heat required to prevent a bubble from cooling when stretched is rather more than half the work spent in stretching it. Hence, if we calculate the work required to stretch it to any stated extent, and multiply the result by $\frac{3}{2}$, we have an estimate, near enough for my present purpose, of the augmentation of energy experienced by a liquid film when stretched and kept at a constant temperature. Taking 0·08 of a gramme weight per centimetre of breadth as the capillary-tension of a surface of water, and, therefore, 0·16 as that of a water-bubble, I calculate (as you may verify easily) that a quantity of water, extended to a thinness of 1-200,000,000th of a centimetre, would, if its tension remained constant, have more energy than the same mass of water in ordinary condition by about 1100 times as much as suffices to warm it by 1° C. This is more than enough (as Maxwell suggested to me) to drive the liquid into vapour. Hence, if a film of 1-200,000,000th of a centimetre thick can exist as liquid at all, it is *perfectly certain* that there cannot be many molecules in its thickness.

The argument from the kinetic theory of gases leads me to quite a similar conclusion.

Ordinary Meeting, April 5th, 1870.

J. P. Joule, D.C.L., LL.D., F.R.S., &c., President, in the Chair.

"*Description of a New Anemometer.*" By Peter Hart.

On the appearance of Mr. Fletcher's admirable paper "On the Speed of Air in Flues," it appeared to me that an anemometer more easily read and less costly than his was desirable. With this view I devised the present one, which may be broadly described as a common U-tube gauge laid in a sloping position, so as to form the hypotenuse of a right-angled triangle, the perpendicular of which is the true reading.

The following description will explain its construction:—

It consists first of a base board furnished with levels and levelling screws; to this is hinged the board carrying the U-tube, which may be called the sloping base; on this sloping base is secured the U-tube furnished with a scale and vernier capable of being read to the 1-100th inch. By means of a screw passing through the sloping base, and resting on the lower base board, the former can be made to assume any angle with the latter, the angle being determined by a quadrant fixed to the lower base board.

By this arrangement a very great degree of accuracy in reading is obtainable. Thus, in the present instrument, the quadrant is set 5 inches distant from the hinge, and when set at 0·5 inches on the quadrant, it gives a rise of 1 in 10; consequently, the ether in the U-tube has to move 10 inches for 1 inch of vertical rise. The rule for getting the result may be stated thus:—

Divide the space between the hinge and the quadrant by the quadrant elevation, now divide the movement of the ether by the quotient, and the product is the true vertical movement *nearly*.

Thus, suppose, as before, the quadrant elevation to be 0·5 inch, the distance from hinge to quadrant 5·0 inches, and the ether's movement 1 inch: then—

$$\frac{5}{0{\cdot}5} = 10 \text{ and } \frac{1{\cdot}0}{10} = 0{\cdot}1 \text{ inch.}$$

Or again, the quadrant elevation being 0·2 inch, the other quantities the same: then—

$$\frac{5}{0{\cdot}2} = 0{\cdot}25 \text{ and } \frac{1{\cdot}0}{1{\cdot}25} = 0{\cdot}04 \text{ inch.}$$

* Will you try this experiment? You would easily make a good log of it.

† *Proceedings of the Royal Society* for April, 1858.

These results, though not absolutely correct, will, in most cases, be sufficiently so; but where rigid accuracy must be had, the following table will supply the means:—

Quadrant Elevation in 10 inches.	Hypotenuse.	Quadrant Elevation in 10 inches.	Hypotenuse.
0·1 inch.....	10·00049	1·1 inch.....	10·06035
0·2 "	10·00199	1·2 "	10·07174
0·3 "	10·00449	1·3 "	10·08414
0·4 "	10·00799	1·4 "	10·09752
0·5 "	10·01248	1·5 "	10·11187
0·6 "	10·01799	1·6 "	10·12714
0·7 "	10·02447	1·7 "	10·14347
0·8 "	10·03199	1·8 "	10·16061
0·9 "	10·04049	1·9 "	10·17888
1·0 "	10·04987	2·0 "	10·19803

First find what aliquot part of 10 the quadrant elevation was; find this in the quadrant column. Opposite this will be found a number which is the hypotenuse. Then, as this number is to 10, so is the number obtained by the first method to the true number.

Thus, to take the first illustration, of 0·5 in 5 inches: this is equal to 1 in 10. The hypotenuse of 1 in 10 (see table) = 10·04987. Now, 0·1 inch was the result obtained. Then, as 10·04987 : 10 : : 0·1 : 0·09955, which is the true vertical rise.

I had no little difficulty in my first efforts to restrain the excessive oscillations of the ether column, owing to the almost constant fluctuations of draught in flues. To obviate this the tube was choked to a narrower bore at the bend. This proving insufficient, I overcame the defect by the very simple means of inserting a piece of sponge at this part.

It is, perhaps, needless to add that it is necessary to employ Mr. Fletcher's tubes for insertion into the flue, and also his tables.

ROYAL INSTITUTION OF GREAT BRITAIN.

Friday, April 1st, 1870.

"*On the Artificial Production of Alizarine, the Colouring Substance of Madder,*" by Prof. H. E. Roscoe, F.R.S., Owen's College, Manchester.

The speaker stated that he had to bring before the notice of his audience a discovery in organic chemistry which, whether we regard its scientific interest or its practical and commercial value, is of the highest importance, and marks an era in the history of the application of chemistry to the arts and manufactures even of greater importance than the memorable discovery made by Mr. Perkin in 1856 of the production of aniline violet, or mauve.

Since the above-named year, great progress has been made in the theoretical investigation of natural and artificial colouring matters, as well as in their preparation on a large scale. The chemistry of colouring matters has now taken a high and important position, and chemists instead, as formerly was their wont, of getting rid of all colouring matters as something foreign to their objects of investigation, have, since Mr. Perkin's discovery, found out that the examination of colouring matters may not only lead to scientific laurels, but may sometimes yield fruit of another and not less acceptable kind.

We owe to the brains and hands of two German chemists, Messrs. Graebe and Liebermann, this remarkable discovery, which differs from all the former results which have been brought about by the application of science to the chemistry of colouring matters, inasmuch as this has reference to the artificial production of a natural vegetable colouring substance which has been used as a dye from time immemorial, and is still employed in enormous quantities for the production of the pink, purple, and black colours which are seen everywhere on printed calicoes, viz. alizarine, the colouring principle of madder.

It is from the liquid tarry products of the destructive distillation of coal, a rich source of interest to chemists, that we now derive this new colouring matter.

The following table contains the results of experiments made on the large scale, indicating the various yields of tar from different qualities of coal distilled in the gas-works of various towns:—

Destructive Distillation of Coal.

100 tons of cannel and bituminous coal distilled to yield 10,000 cubic feet of gas of sp. gr. 0·6, yield the following products:—

	Gas.	Tar.	Ammonia Water.	Coke.	
1	22·25	8·50	9·50	59·75	Average of many experiments.
2	20·01	7·85	7·14	65·00	Manchester.
3	20·40	6·40	5·40	67·85	Dukinfield.
4	21·70	7·50	5·80	65·00	Macclesfield.
5	16·30	10·70	8·00	65·00	Salford.

From a careful series of experiments made by a large tar distiller, the following numbers are derived, showing the average composition of gas tar:—

100 tons of tar on distillation yield:—

	Naphtha.	Light Oils, and Carbolic Acid.	Heavy Oils, Naphthalene, Anthracene.	Pitch.	Water, Gas, and Loss.
1.	3·0	1·5	35·0	50·0	10·5
2.	3·0	0·8	25·0	60·0	12·2

It is from benzol, C_6H_6, discovered by Faraday in 1825, that the aniline colours are all of them prepared. The colour-producing power of the coal products is, however, yet far from being exhausted. It is by means of another, and hitherto comparatively unknown, hydro-carbon, anthracene, $C_{14}H_{10}$, that the newest triumphs of the chemist have been won. This is a substance which in the pure state few chemists (even yet) have seen, and upon which only two or three had previously experimented, and yet by one happy discovery—and by an investigation which more than almost any other exhibits the value of the synthetic power of modern research—this unknown body has been made to yield a colouring matter of the greatest possible value. The truth of this will at once be evident when we learn that the total growth of madder is estimated to reach 47,500 tons per annum, worth £45 per ton, and having, therefore, a value of £2,150 000. Of this, nearly one-half is used in the United Kingdom, so that no less a sum than £1,000,000 is now paid by us for madder grown in foreign countries. This will now, in part at least, go to benefit our own population, as we can now transform our coal into this invaluable colouring matter.

In an experiment made on a large scale it was found that 100 tons of tar yielded 0·63 ton of anthracene, or 1 ton of anthracene can be obtained from the distillation of about 2000 tons of coal, not reckoning the quantity of anthracene contained in the pitch.

Madder is the root of several species of Rubia, amongst which the *Rubia tinctorum* is the most valued for its dyeing properties. This grows in Holland, Asia Minor, and in the south of France and of Russia. A species native to England is the *Rubia peregrina*. This belongs to the order *Rubiaceæ*, the native members of which, as the Galiums, are mostly inconspicuous wild plants. Some of the foreign species are, on the contrary, important plants, such as the cinchona, ipecacuanha, and coffee plants, and these are distinguished for the number and variety of the peculiar principles which they yield, as quinine, cinchonine, caffeine, alizarine. Thanks to the kindness of Dr. Schunck, the speaker was able to show a young madder plant.

In spite of the many investigations which have been made of madder, chemists are still in doubt as to the nature of many of its constituents. Some attribute its colouring powers to the presence of at least two substances—alizarine and purpurine—while others say that only one of these produces the true madder colours.

Alizarine was discovered and obtained from madder, as a crystalline sublimate, by Robiquet and Colin, in 1831, but little importance attached to this discovery until Schunck, in 1848, showed that all the finest madder colours contain only alizarine combined with bases and fatty acids. The second colouring matter, termed purpurine, was discovered by Persoz. It contributes to the full and fiery red colour in ordinary madder dyeing, but dyes a bad purple, alizarine being essential to the latter. Purpurine disappears during the purifying processes of soaping, &c., being far less stable than alizarine. It is distinguished from alizarine by its solubility in boiling alum liquor.

These two colouring principles may likewise be easily distinguished by the spectrum, alizarine producing a set of dark absorption bands, quite different from those of purpurine, which again vary according to the nature of the solvent. Alizarine can be obtained in yellow needle-shaped crystals by simple sublimation from the dried madder; but this colouring matter is, singularly enough, not contained ready formed in the fresh madder root, but is the product of a peculiar decomposition. For a proof that fresh madder does not contain alizarine we have only to extract the moist root with alcohol, when neither the alcoholic extract nor the insoluble residue will be found to possess tinctorial power. We owe this knowledge to the researches of Schunck and Higgin, who have proved that alizarine is produced by a peculiar kind of fermentation, which partly occurs in the root on standing, and partly takes place in the dyebeck, when the powdered madder is treated with water. A crystalline glucoside, termed rubianic acid (Schunck), is contained in the root, and it is this which splits up simply into alizarine glucose. This acid crystallises in fine yellow needles, and gives a definite and crystalline potash salt, from which it was shown to contain 26 atoms of carbon in the molecule. Hence, as no other product but glucose is formed, it follows that alizarine must contain $C_{26} - C_{12} = C_{14}$. This decomposition of rubianic acid into alizarine was shown by boiling with an acid, and adding caustic soda when the blue solution of alkaline alizarine was seen. The formation of alizarine in extracts of madder root is effected by a ferment peculiar to the plant, and called erythrozym. It is a ferment *sui generis*, since no other ferment produces the same effect. When mixed with a solution of rubian or rubianic acid, at the ordinary temperature, the latter is rapidly decomposed as with acids. This is what takes place in making *fleur de garance*. Dyers raise the temperature of their madder-baths gradually up to the boiling point, because the application of a high temperature destroys the ferment. When the temperature is gradually raised, the ferment acts upon the glucoside, and produces alizarine.

That the colouring matter in fresh madder root is not alizarine can be easily shown by rubbing the soft portions of the root on to paper, when a yellow stain will be produced, which, on treatment with an alkali, shows the bright red colour of an alkaline solution of rubian instead of the blue solution of alizarate.

According to Schunck, the origin of purpurine, and its relation to alizarine, are still involved in obscurity.

The hypothesis which of late years has done more than any other to stimulate experiment and enlarge our views in organic chemistry is undoubtedly Kekulé's theory of the tetrad nature of carbon and his explanation of the constitution of the carbon compounds. In the so-called paraffine group of organic substances, the carbon atoms are supposed to be connected together by single links of the four bonds attached to each atom, thus giving rise to saturated compounds by the attachment of other elements or radicals to the free bonds. In the group of aromatic substances with which we are specially concerned the carbon atoms are more closely linked together, or, in other words, a less number of atoms of hydrogen are necessary to saturate an aggregation of carbon atoms than is the case in the other group. We can explain this, upon the assumption of the tetrad character of carbon, by supposing that each carbon atom is attached to its neighbour alternately by one and by two bonds.

Another singular property of these aromatic bodies is that they all contain at least six atoms of carbon, and that the simplest hydrocarbon of which they are made up is benzol, C_6H_6. So that we may regard all these aromatic compounds as benzol derivatives, and this hydrocarbon may be considered as the skeleton round which many complicated substances are arranged. So that by the replacement of one atom of hydrogen by NH_2, we obtain aniline, by OH phenol, &c. From the knowledge gained by his investigation on the quinones, Graebe came to the conclusion that alizarine belongs to the quinone series; and, availing themselves of Baeyer's reaction, by which phenol can be converted into its hydrocarbon, benzol, Graebe and Liebermann passed the vapour of natural alizarine obtained from madder over heated zinc-dust, and found that the hydrocarbon they formed was identical in all its properties with anthracene, $C_{14}H_{10}$, from coal tar. Hence they confirmed Schunck's conclusions that the molecule of alizarine contains fourteen atoms of carbon. Having thus got hold of the backbone, as it were, of the compound, it only remained for them to clothe the hydrocarbon with the four additional atoms of oxygen and to take off the two atoms of hydrogen in excess, in order to obtain alizarine.

Laurent and also Anderson had, many years ago, obtained a body of the composition $C_{14}H_8O_2$, and Graebe recognised this as the quinone of anthracene; and he now only required to replace in this two atoms of hydrogen by two of hydroxyl (OH), in order to obtain alizarine, which clearly appeared to be a quinone acid—

$C_{14}H_{10}$	$C_{14}H_8(O'')_2$	$C_{14}H_6\begin{cases}O_2''\\OH\\OH\end{cases}$
Anthracene.	Anthraquinone.	Alizarine.

This replacement of hydroxyl can be effected by bromine, by which bibromanthraquinone $C_{14}H_6Br_2O_2$ is formed, and this, on fusion with caustic potash, gives potassium alizarate, yielding pure alizarine on treatment with hydrochloric acid. The high price of bromine rendered this process unavailable for manufacturing purposes, and hence another plan was simultaneously proposed by several chemists for effecting the same end in a cheaper mode. Use was hereby made of Kekulé's and Wurtz's reaction in the formation of sulphobenzolic acid. On treating anthraquinone with strong sulphuric acid to a high temperature, the di-sulpho acid—

$$C_{14}H_6O_2\begin{cases}SO_3H\\SO_3H\end{cases}$$

is formed, and this on heating with concentrated solution of potash, yields the sulphite and alizarate of potassium; from the latter substance pure alizarine is obtained by the action of acids.

In the following table we have a statement of the synthetic production of alizarine from its constituent elements.

Synthesis of Alizarine.

1. Acetylene by direct union of carbon and hydrogen in electric arc.
$$C_2+H_2=C_2H_2 \quad \text{(Berthelot, 1862.)}$$
2. Benzol (tri-acetylene) from acetylene by heat.
$$3C_2H_2=C_6H_6 \quad \text{(Berthelot, 1866.)}$$
3. Anthracene from benzol and ethylene.
$$2C_6H_6+C_2H_4=C_{14}H_{10}+3H_2 \quad \text{(Berthelot, 1866.)}$$
4. Alizarine from anthracene. (Process No. 1.) (Graebe and Liebermann, 1869.)
   (A) Oxyanthracene or anthraquinone by nitric acid.
   $C_{14}H_6(OH)_2$ (Anderson, 1861.)
   (B) Bibromanthraquinone by action of bromine.
   $$C_{14}H_8O_2+2Br_2=C_{14}H_6Br_2O_2+2BrH$$
   (C) Alizarine by action of caustic potash.
   $$C_{14}H_6Br_2O_2=4KHO=C_{14}H_6(OK)_2O_2+2KBr+2H_2O$$
   Potassium alizarate.

[English Edition, Vol. XXI., No. 543, pages 185, 186.]

5. Alizarine from anthracene. (Process No. 2.)
(Graebe and Caro, Perkin, Schorlemmer, and Dale.)

(A) Disulphoanthraquinonic acid from anthraquinone.

$$C_{14}H_6(OH)_2+2H_2SO_4=C_{14}H_6O_2\left\{\begin{matrix}SO_3H\\SO_3H\end{matrix}\right\}+2H_2O$$

(B) Alizarine from the above by the action of potash.

$$C_{14}H_6O_2\left\{\begin{matrix}SO_3H\\SO_3H\end{matrix}\right\}+4KHO=$$

$$=C_{14}H_6O_2\left\{\begin{matrix}OH\\OH\end{matrix}\right\}+2K_2SO_3+2H_2O$$

Alizarine.

Mr. Perkin states that an intermediate substance is formed in this reaction having the formula—

$$C_{14}H_6(O)_2''\left\{\begin{matrix}OK\\OSO_3,\end{matrix}\right.$$

and this, when heated with potash, splits up into alizarine and a sulphite. Other yellow-coloured products are, according to Perkin, contained in the alizarine as sent out from his manufactory. The nature of these yellow crystalline bodies is as yet unknown.

Of the identity of the natural with the artificial alizarine there can be no doubt: they agree in all their physical and chemical properties. Their absorption spectra are identical, their tinctorial powers are the same; the coloured lakes which they form with alumina, iron, and copper salts, are of the same tint, and possess the same degree of solubility, and these remain alike unaltered by the action of light, so that when they are fixed in the cotton-fibre they yield equally fast colours.

It is difficult to predict how far the artificial alizarine will in future restrict the growth of madder; but there is no doubt that for many styles of calico-printing the artificial alizarine is of the greatest value, and we may naturally expect to see very important changes effected in this branch of chemical industry in the further practical application of this new discovery.

Contributions to the History of Alizarine. $C_{14}H_8O_4$.

1825. Faraday discovered benzol in coal-gas oil. C_6H_6.
1831. Robiquet and Colin discovered alizarine in madder root.
1832. Dumas and Laurent discovered anthracene in coal oils.
1848. Schunck gave the composition of alizarine, $C_{14}H_{10}O_4$.
1850. Strecker gave the composition of alizarine, $C_{10}H_6O_3$.
1862. Anderson examined anthracene compounds, $C_{14}H_{10}$.
1865. Kekulé explained the constitution of the aromatic compounds.
1866. Baeyer obtained benzol from phenol.
1868. Graebe investigated the quinones.
1868. Graebe and Liebermann obtained anthracene from alizarine.
1869. Graebe and Liebermann obtained alizarine from anthracene.

NOTICES OF BOOKS.

The Private Life of Galileo. Compiled principally from his correspondence, and that of his eldest daughter, Sister Maria Celeste, Nun in the Franciscan Convent of S. Matthew, at Arcetri. London: Macmillan and Co. 1870. 307 pages.

We are extremely glad to welcome the issue of another life of Galileo; for, although many such have been published, they have, for the most part, appeared in Italy and France, and are but little known in this country. The most detail work is perhaps Albèri's "Opere Complete di Galileo Galilei," which was published in Italy, between 1842 and 1856. In this country, we scarcely know where to look for a work which gives anything like a definite idea of Galileo's works, of his life, and of the times in which he lived; and, although the work before us purports to be confined to his private life, it contains many interesting details in regard to his scientific labours, and his persecution by the Church of Rome.

Galileo was the eldest son of Vincenzio de' Bonajute de' Galilei, a Florentine nobleman, and was born at Pisa, on the 18th of February, 1564. His father appears to have been a man of great culture, and was the author of several works on counterpoint, which, having been invented about the twelfth century, had attained some degree of perfection by the sixteenth. Galileo acquired a great love for music from his father, and is said to have excelled him as a performer on the lute; throughout his life, especially when blindness and bodily ills were added to his other troubles, he delighted in the soothing effect of his instrument. In painting Galileo also excelled, and it is probable that, if he could have chosen his profession, he would have become a painter.

In 1581, at the age of seventeen, Galileo was sent to study medicine at the University of Pisa, an intensely conservative institution, where Aristotle, and Aristotle only, was considered the fountain-head of all knowledge.

It was during his residence at Pisa that he discovered the pendulum. He noticed the extreme regularity of the oscillation of the great bronze lamp in the nave of the Cathedral, and was thus led to imagine that an instrument might be constructed which, by the alternation of its oscillations, would mark the regularity and variation of the pulse. This instrument he constructed, and it was much used by the physicians of the day, under the name of *pulsilogia*.

When we remember how great a mathematician Galileo became, it is strange to learn that the study of mathematics was entirely neglected in the University of Pisa, and, indeed, in Italy generally. It was considered a waste of time to solve problems, and the name of Euclid was almost unknown; indeed, Galileo was obliged to pursue his mathematical studies clandestinely, and it was only when his father saw that he possessed an extreme aptitude for them that he permitted them to be continued. Accordingly, Galileo worked hard at the writings of Euclid and Archimedes; he reached the sixth book of the former, and had already invented several problems. In 1586, while studying the works of Archimedes, he composed his first essay on the "Hydrostatic Balance," which was not published, however, till 1615. In 1588, he wrote his "Theoremata Circa Centrum Gravitatis Solidarum," which was not published till 1638, and then in the form of an appendix to the fourth of the celebrated "Dialogues." The "Essay on the Centre of Gravity of Bodies" led to the introduction of Galileo to Ferdinand, Grand Duke of Tuscany, who appears to have admitted him to a considerable degree of intimacy. In 1589, Galileo was appointed Professor of Mathematics at Pisa, with a salary of sixty crowns per annum, that is, about ten-pence per day. With one exception, Galileo had not a friend among the Pisan Professors, for they were firm believers in Aristotle; and, when Galileo proved the falsity of Aristotle's laws regarding falling bodies by experiments in public, made on the summit of the Leaning Tower of Pisa, the anger of his colleagues was soon made manifest. In 1592, Galileo resigned the Professorship at Pisa, and became Professor of Mathematics in the University of Padua, with a salary of 180 florins a-year (about £32). The Paduans recognised his genius somewhat tardily: when he had been among them seventeen years, the Senate of the University, bearing in mind his discovery of the telescope, and his labours "to the gain of the University, and to the satisfaction of all," gave him the Professorship for life, with a salary of a thousand florins.

In 1609, Galileo invented the telescope. It was first called *cannochiale* or *occhiale* (eye-glass); and the term *telescope* was introduced by Prince Fredrigo Cesi. The invention was very much combated, even by Galileo's own countrymen; it was claimed by the Dutch, and many older

writers (among them Baptista Porta and Antonio De Dominis) were mentioned as prior inventors. By means of the new instrument, Galileo discovered the satellites of Jupiter, in 1610; he called them *Medicea Sidera*, in honour of Cosmo de' Medici and his brothers, Francesco, Carlo, and Lorenzo. Galileo constructed more than a hundred telescopes, and sent them as presents to various monarchs and princes of Europe; only ten of them were capable of showing the satellites of Jupiter. The excitement created by the invention was intense; everyone was anxious to see the new instrument: "we are told how Marie de' Medici, in her eagerness to see the moon through the telescope, would not wait for it to be adjusted, but went down upon her knees before the window, thereby greatly astonishing the Italian gentleman who had brought the telescope into the royal presence." In July, 1610, Galileo discovered Saturn's Ring; in the following October, the phases of Venus; and, in March, 1611, the solar spots.

In 1613, Fra Benedetto Castelli, a pupil of Galileo, was appointed Professor of Mathematics at Pisa, but was specially cautioned to make no mention of the Copernican theory of the earth's motion, which, since the discovery of Jupiter's satellites, had been somewhat openly discussed. Galileo wrote to Castelli, during the course of this same year, on the subject of the Copernican theory, and asserted that the Ptolemaic system (then received by the Church) did not, in many respects, accord with Scripture. We may quote a few passages of this celebrated letter in full:—"But I should in your place have added that, though Scripture cannot err, its expounders and interpreters are liable to err in many ways; and one error in particular would be most grave and most frequent if we always stopped short at the literal signification of the words. For, in this wise, not only many contradictions would be apparent, but grave heresies and blasphemies; for then it would be necessary to give God hands, and feet, and ears, and human and bodily emotions, such as anger, repentance, hatred, and sometimes forgetfulness of things past, and ignorance of the future." . . . "And who can assert or sustain that, in speaking incidentally of the sun, or of the earth, or of other created bodies, Scripture should have elected to restrain itself rigorously to the strict signification of the words used? May it not be that, had the truth been represented to us bare and naked, its intention would have been annulled, from the vulgar being thereby rendered more contumacious and difficult of persuasion in the articles concerning their salvation?" A copy of this private letter, obtained, it is believed, by treachery, fell into the hands of the Dominicans of the Convent of S. Mark, and incensed them to such a degree that they determined at once to denounce Galileo to the Holy Office, and, if possible, procure his destruction. The controversy was immediately introduced into the pulpit; and the Dominican Caccini preached a violent anti-Copernican sermon, at S. Maria Novella, on the punning text, "Ye men of Galilee, why stand ye gazing up into Heaven?" The opponents of Copernicus (who, in reality, knew nothing about him) forgot that he was a Canon of their Church, and had been summoned to Rome by Leo X., to the Council of the Lateran, in order to re-model the Church Calendar. Caccini was ordered to repair to Rome, and was examined in March, 1615, in regard to what he knew of Galileo and his followers. Both Caccini and Lorini denounced Galileo to the Holy Office, and thus paved the way to the celebrated trial of 1633. Near the close of the year 1615, Galileo went to Rome to plead his own cause. Early in the following year, he had an interview with the Pope (Paul V.), who conversed with him for three-quarters of an hour, and was altogether very gracious, assuring him that he need fear no persecution by the Congregation of the Holy Office, during his Pontificate. Paul V. died in 1621, and Gregory XV. was elected in his stead, but he reigned only two years; and, in August, 1623, Maffeo Barbarini became Pope, and assumed the title of Urban VIII. When Cardinal, the new Pope had been on somewhat intimate terms with Galileo; had called him "affectionate brother," and had written Latin sonnets in praise of his works. It was hence imagined by the reform party that science would find a patron and protector in Urban; Galileo, indeed, went so far as to hope and imagine that he would recognise the Copernican theory. "Under the auspices of this most excellent, learned, and benignant Pontiff," wrote Prince Cesi, "science must flourish. . . . Your arrival will be welcome to his Holiness. He asked me if you were coming, and when; and, in short, he seems to love and esteem you more than ever." In April, 1624, Galileo started for Rome, where he remained about two months, during which time he had six interviews with the Pope, who gave him various presents on his departure, and "an ample provision of Pontifical love."

Galileo's "Dialogue on the Ptolemaic and Copernican Systems" had for many years been partially written. It was finally concluded in March, 1630; and, in the following May, Galileo went to Rome to make arrangements for its publication. Urban VIII. gave him permission to publish the work with certain slight alterations and additions: but, at the same time, to his great disappointment, told him that the Copernican system could not be recognised by the Church, and must be treated as mere hypothesis. The "Dialoghi" appeared in January, 1632, and was favourably received by all Italy. Suddenly, however, about six months after its appearance, an order was issued from the Master of the Sacred Palace to sequestrate every copy throughout Italy, on the authority of the Jesuit Inchofer, one of the Consultori. The Grand Duke of Tuscany, the principal patron of Galileo, wrote at once to Niccolini, his Ambassador at Rome, to enquire the cause of the sudden change of the Pope's views. Niccolini at once requested an audience. When Galileo was mentioned, Urban became furious; he said he had grossly deceived him, and had dared to publish matters which ought never to have been so much as mentioned; moreover, that the Papal suggestions had not been complied with. The Jesuits ruled the Roman Court then, as now; and certain Jesuits of influence instilled into the Pope's mind the fabrication that, in the person of Simplicio (one of the three characters in the "Dialogues"), Galileo had intended to hold him, the Sovereign Pontiff, up to ridicule. This, once admitted by Urban, sealed the fate of Galileo and of his work. In October, 1632, he was cited to appear at once before the Inquisition; and, although everything was urged against his appearing in person for trial, the Pope would listen to no excuse. Galileo was very old and feeble, and his health was bad. It must be confessed that the three doctors who drew up the medical certificate of the state of his health made the very best case they could for their client, in regard to his unfitness for the journey to Rome. They found him to possess an intermittent pulse and a certain amount of debility; then comes the heaping up of bodily ills—"Riferisce il detto patire di vertigini frequenti, di melancolia hipocondriaca, debolezza di stomaco, vigilie, dolori vaganti per il corpo, si come da altri può essere attestato. Co se anco haviamo riconosciuto un hernia carnosa grave con attentatum del peritoneo." It was no use, however; the Inquisition would not spare him; and he was forced to make the journey to Rome during mid-winter, through a bleak and dreary region.

Now, his trial and the results thereof, and his abjuration, and imprisonment, and the sentence (which included a recitation of the seven penitential Psalms once a week for three years), are they not written in numerous and diverse books, and, to a greater or less extent, in the minds of all of us? One thing we must allude to, in conclusion: it is usually said that, when Galileo rose from his knees, after abjuring the doctrine of the earth's mobility, he muttered—*Eppure si muove!* ("It *does* move, notwithstanding"). The author of the work before us very justly remarks,—"This is one of those fine things which are put into the mouths of great men, but which, in fact, are not said, except by their biographers. It is, indeed, impossible that Galileo

should have uttered such words as would have caused his instant consignment to the deepest dungeons of the Inquisition." We remember a recent example of these fine sayings which are put into the mouths of great men. When the Tsar was fired at, in 1867, during his visit to Napoleon III., there were no less than *seven* different statements, in various Paris papers, of the sayings of the Emperor and the Tsar the moment after the shot had been fired. These sayings were so evidently dramatic in their character, and unlike the real remarks which might be expected to be made under such circumstances, that the wonder is they obtained a moment's credence. We remember but one of them—"Sire," said Napoleon III., "we have been under fire together." "Our destinies," replied the Tsar, "are in the hands of Providence." M. Ponsard has not allowed such an incident as the *Eppure si muove* saying to pass unnoticed in his "Galilée;" indeed, he makes it the culminating-point of the drama, and also ingeniously gives Mde. Favart a last chance of showing her filial affection as Antonia—

"*Le President, à Galilée.*
La prison qu'on t'assigne est un cloitre à Livourne,
Antonia, se jetant dans les bras de Galilée.
Va, nous t'y suivrons, père.
Galilée, à part, en se relevant et en frappant du pied en terre.
Et pourtant elle tourne."

Let us add one word, in conclusion, in regard to the treatment of Galileo by the Church, and his actual position. It has been the custom to see in him only an injured and persecuted man; to absorb everything appertaining to the man into the martyr. A lot of nonsense and rant has been written against the Church of Rome, because it suppressed his book; while we forget what our own Church, which pretends to no bigotry, has done; and how, even now, more than two centuries from the time of Galileo, a very little matter of assumed heterodoxy arouses the whole Bench of Bishops, and renders Church literature inflammatory, and often unjust. We need scarcely allude to a recent example of this; and, while it is before us, we may not cry shame on Rome for her treatment of Galileo. Next, as to the man: he is called "the originator of true experimental philosophy," "the father of modern natural philosophy," and so on; some put him before Bacon and Descartes; some assert that he caused the downfall of Aristotelianism. Expressions and ideas of this kind become stereotyped in the human mind. They are bandied about from book to book, and from mouth to mouth; they are accepted without comment; and the full question is rarely examined and weighed. The attitude of human thought in such matters of hearsay and tradition is intensely conservative; its inertia is enormous; its condition of stability is established, and cannot easily be altered. Without doubt, Galileo ranks among the greatest natural philosophers which the world has ever seen: his discoveries are numerous and great; his influence on modern philosophy, although less than that of Bacon and Descartes, was undeniably great. A great many people, however, ignore the fact that Copernicus originated the theory of the earth's mobility, and that there were ten Copernicans in Europe in the sixteenth century, one of whom was our Gilbert, of Colchester. As regards the downfall of Scholasticism, the way had been prepared for this by such men as Aconcio, Nizolius, and Telesius. But most eminent among them all, as one who fearlessly and in the face of persecution asserted the truth and strove to break down the old barriers, was Savonarola. Free thought, and open expression of it, had been practised long before the time of Galileo. The world was ripe for the change. Galileo did not till the soil; he did not even sow the seed; but he helped to garner a mighty harvest. It is right that he should be one of the glories of science; but, to be just, we must not allow enthusiasm to distort our estimate of his chequered and not always admirable life.

First Report of the Commissioners Appointed in 1868 *to Inquire into the Best Means of Preventing the Pollution of Rivers.* (*Mersey and Ribble Basins.*) Vol. i. 1870.*

We have here a folio volume of some 140 pages, containing, as may be imagined, an enormous amount of condensed useful and highly interesting information. The work is divided into two main parts—viz., River Pollution (subdivided into two sections—A, Descriptive; B, Remedies) and Water Supply. The River Pollutions are classed under two heads—viz., Sewage and Manufacturing Refuse. The chemical difference between polluted and unpolluted water is clearly defined as follows:—

"Absolutely pure water is not to be found in nature. Even at the moment of its condensation in the atmosphere from invisible vapour to visible cloud, water absorbs gases, and becomes also contaminated with a fine dust which is everywhere floating in the air. When it falls to the earth as rain, it percolates through strata, or flows over surfaces more or less soluble, and dissolves, according to circumstances, quantities of solid matter varying generally from about 3 lbs. to 50 lbs. in 100,000 lbs. of water. In addition to these inevitable impurities, natural and unpolluted water is not unfrequently turbid from insoluble substances suspended therein in a finely-divided condition.

"The following are the chief characteristics of unpolluted water:—It is tasteless and inodorous, possesses a neutral or faintly alkaline reaction, rarely contains in 100,000 lbs. more than ½ lb. of carbon and 1–10th lb. of nitrogen in the form of organic matter, and is incapable of putrefaction even when kept for some time in close vessels at a summer temperature.

"Of the different kinds of pollution affecting rivers, animal organic matter, as it occurs in sewage, is that which renders water not only most offensive to the senses, but most likely to injure health, both by its gaseous emanations and by its deleterious effects when used as a beverage. Rivers so polluted frequently contain from 1 lb. to more than 2 lbs. of organic carbon, and from ⅛ lb. to ¼ lb. of organic nitrogen, in 100,000 lbs. Pollution by vegetable organic matter, such as that caused by dye and print-works, stands next as regards offensiveness; water so polluted being excessively unpleasant, not only to the sight, but also, in warm weather, to the sense of smell. It often contains, in 100,000 lbs., twice as much organic carbon as is present in water polluted by sewage, but, owing to the comparatively small proportion of nitrogen in vegetable substances, it rarely contains more than one-third of a pound of organic nitrogen. Chemical works contribute chiefly mineral impurities, which often communicate to water extreme hardness and other disagreeable and even poisonous properties."

The following is a brief summary of the chemical researches instituted:—

"(*a.*) The total amount of solid matters present *in solution*:—The most important constituents of these solid matters are—

"1. Organic carbon.

"2. Organic nitrogen.

"3. Ammonia in the form, chiefly, of carbonate of ammonia.

"4. Nitrogen in the form of salts of nitric acid and nitrous acid.

"5. Total combined nitrogen—This determination sums up the whole of the analytical evidence against the water, as regards both past and present organic contamination.

"6. Chlorine. The proportion of chlorine in water may often be used as an indication of the extent to which a stream has been contaminated with *sewage*, as distinguished from *solid* animal matters. The chlorine in river water is almost always combined with sodium as common salt, which is a large and essential constituent of urine, and consequently of sewage, whilst it is present in only comparatively minute

* The Commissioners are Dr. Frankland, F.R.S., Sir William Denison, F.R.S., and Mr. J. C. Morton.

quantity in solid manure. It is scarcely necessary to say, however, that the determination becomes valueless for this purpose in the neighbourhood of the sea and of natural deposits of salt—such as that existing in the Valley of the Weaver, for instance. The normal proportion of chlorine, as common salt, existing in this country in waters which have never been polluted by excrementitious matters, is about 1 part in 100,000 of water. Most of this is probably carried from the ocean to the land through the air as sea-spray or fine particles of salt; for we find that the unpolluted waters of an inland country like Switzerland contain only about 0·2 part of chlorine in 100,000 parts.

"7. Hardening constituents.

"(*b.*) The total amount of solid matters *in suspension*:—In this it is very important to distinguish between organic and mineral matters. We have therefore determined—

"1. The organic matters in suspension.

"2. The mineral matters in suspension."

The alleged self-purification of polluted rivers, a subject of paramount importance, is treated of in the following terms:—

"At the time the winter samples were taken, the rivers were not in a state of putrefaction; any purification which they underwent during their progress towards the sea was, therefore, produced at this time either by the oxidation of the polluting organic matter contained in the solution, or by the subsidence of the suspended matters. It has often been stated, but, so far as we know, without any proof, that the organic matter contained in sewage and other similar polluting materials is rapidly oxidised during the flow of a river into which such materials are discharged. Thus, it has been asserted ("Report of Royal Commission on Water Supply," p. 79), that if sewage be mixed with twenty times its volume of river water, the organic matter which it contains will be oxidised and completely disappear whilst the river is flowing 'a dozen miles or so.' We thought it very undesirable that a subject of such vital importance to our inquiry should any longer rest upon mere opinion, and we therefore determined to submit it to careful experimental investigation. During our winter visit to the basins of the Mersey and Ribble, a very favourable opportunity presented itself for the solution of this important problem. The river Mersey, after receiving the drainage of many towns and manufactories above the Stretford Road Bridge, flows thence 13 miles, to its junction with the Irwell, without encountering any other material source of impurity, although its volume is somewhat augmented by unpolluted affluents. The river Irwell, after passing Manchester, falls over a weir at Throstlenest, and runs 11 miles, to its junction with the Mersey, without further material pollution, and with but very unimportant unpolluted affluents. Lastly, the river Darwen, which is greatly polluted by the sewage of Over Darwen, Lower Darwen, and Blackburn, joins the Blakewater just below the latter town, and then flows 13 miles, to near its junction with the Ribble at Walton-le-Dale, without any further pollution, although its volume becomes more than doubled in this part of its course by the accession of the river Roddlesworth, the Alum-House brook, and numerous small affluents, all of which are unpolluted.

"We took samples of water at the top and bottom of the courses of these rivers at the places just indicated, viz.—1. The Mersey at Stretford Road Bridge, and again just before its junction with the Irwell. 2. The Irwell, as it fell over the weir at Throstlenest, and again just before its junction with the Mersey; similar samples of this river being also taken in May and June following. 3. The Darwen, one-third of a mile below its junction with the Blakewater, and again 50 yards above the bridge at Walton-le-Dale."

The main result of these experiments is summarised in the following words:—

"It is thus evident that, so far from sewage mixed with 20 times its volume of water being oxidised during a flow of 10 or 12 miles, scarcely two-thirds of it would be so destroyed in a flow of 168 miles, at the rate of 1 mile per hour, or after the lapse of a week. But even this result is arrived at by a series of assumptions which are all greatly in favour of the efficiency of the oxidising process. Thus, for instance, it is assumed that the 62·3 per cent of sewage is thoroughly oxidised and converted into inoffensive inorganic matter; but the experiments showed that, in fact, no sewage whatever was so converted or destroyed, even after the lapse of a week, since the amount of carbonic acid dissolved in the water remained constant during the whole period of the experiment; whilst, if the sewage had been converted into inorganic compounds, the carbonic acid, as one of these compounds, must have increased in quantity.

"Thus, whether we examine the organic pollution of a river at different points of its flow, or the rate of disappearance of the organic matter of sewage when the latter is mixed with fresh water and violently agitated in contact with air, or, finally, the rate at which dissolved oxygen disappears in water polluted with 5 per cent of sewage, we are led, in each case, to the inevitable conclusion that the oxidation of the organic matter in sewage proceeds with extreme slowness, even when the sewage is mixed with a large volume of unpolluted water, and that it is impossible to say how far such water must flow before the sewage matter becomes thoroughly oxidised. It will be safe to infer, however, from the above results, that there is no river in the United Kingdom long enough to effect the destruction of sewage by oxidation."

This is confirmed by the evidence given by Sir B. Brodie, before the former Rivers Pollution Commission, in the following words:—

"I should say that it is simply impossible that the oxidising power acting on sewage running in mixture with water over a distance of any length is sufficient to remove its noxious quality. Taking the case of Oxford: if the sewage of Oxford was, in its entirety, discharged into the river Thames, I should say that we could certainly not trust to the oxidising power to take away the noxious quality of the water before it reaches, say, Teddington. I presume that the sewage could only come in contact with oxygen from the oxygen contained in the water, and also from the oxygen on the surface of the water; and we are aware that ordinary oxygen does not exercise any rapidly-oxidising power on organic matter. I believe that an infinitesimally-small quantity of decayed matter is able to produce an injurious effect upon health; therefore, if a large proportion of organic matter was removed by the process of oxidation, the quantity left might be quite sufficient to be injurious to health. With regard to the oxidation, we know that, to destroy organic matter, the most powerful oxidising agents are required; we must boil it with nitric acid and chloric acid and the most perfect chemical agents. To think to get rid of organic matter by exposure to the air for a short time is absurd."

While pollution of rivers by sewage is a more ordinary feature of their contamination, we need not refer here to this point any further, but prefer to lay before our readers some curious facts in relation to pollution by manufacturing refuse, alluded to in general terms in the following words:—

"The operations carried on in bleaching, dyeing, and printing calicoes involve the pollution of large volumes of water, partly by mineral, but chiefly by organic matters. In most cases, the colouring matters, which it is the object of the manufacturer to fix upon the tissues, are contained in but very small proportion in the dye-stuffs employed; thus the weight of actual colouring matter in 1 ton of madder is not more than 2¼ lbs.; hence, nearly the whole of these dye-stuffs is refuse matter, which, partly in solution, and partly in the solid condition, is carried by the goit of the mill into the adjacent stream. According to Mr. Robert Hammond (Messrs. Bradshaw, Hammond, and Co), Reddish Vale Printworks, near Stockport, who has kindly made some careful experiments for us on this point, only 25 per cent of the madder used for dyeing goes into the stream in a state of suspension; the remainder, being rendered soluble in the processes of dyeing and garancine making, consequently enters the stream in solution; hence the large proportion of

organic carbon and organic nitrogen in solution in the effluent water. Mr. Hammond states that 100 tons of ground Turkey madder-root leave, after being used for dyeing, 48½ tons of dry spent madder; this, when made into garancine in the usual manner, and afterwards used for dyeing, leaves 25 tons of dry spent garancine. The returns show that this spent garancine is habitually put into the river or goit. With the exception of a small proportion of the mordants, and of the starch which is used in stiffening the finished goods, all the remaining chemicals find their way into the stream, since they are used in scouring, washing, and cleansing, and are not contained in the goods sent out of the factory. We may gain some idea of the extent of the pollution arising from the processes in question by considering the annual consumption of dye-stuffs, chemicals, and other materials, in one such factory of about average size. The Kinder Printing Company, at Hayfield, Derbyshire, have their works situated on the Kinder brook, a tributary of the Goyt; they employ 250 hands, and use annually—

Madder	200 to 250 tons.
Peachwood	3·8 tons.
Logwood	26·0 "
Sumach	7 9 "
Sulphuric and muriatic acids	100 to 125 tons.
Soda-ash	50 tons.
Bleaching powder	14 "
Lime about	30 "
Soap	44 "
Liquid arseniate of soda, containing 833·2 lbs. of metallic arsenic	19 "
Cow's dung	157 "
Starch	49 "
British gum	19 "

"The quantity of polluted water sent out from these works is estimated at 500,000,000 gallons per annum. It is passed through a series of small settling tanks, and then strained through canvas, to intercept the coarser particles of madder, which are either converted into garaneux and re-used for dyeing, or (exceptionally in these works) put upon land, or burnt. After passing the canvas strainer, the polluted water traverses rapidly a serpentine canal 258 yards in length, and then falls into a culvert, which conveys it below the next printworks on the stream, the works of the Hayfield Printing Company."

The result of the analytical researches made on this subject by the Commissioners show that the prominent character of this form of pollution is like that of sewage organic matter; but the organic matter of dye-water is much less highly nitrogenised than that of sewage, and is therefore, presumably, less putrescible, and, consequently, less offensive. Amongst the mineral polluting materials "of calico-print-works, arseniate of soda alone demands especial notice. About fifteen years ago, it was discovered that arseniate of soda increased both the economy and efficiency of the dung-bath, and a mixture of cow's dung and arseniate of soda appears to have now to a great extent superseded the older mixtures in this part of the calico-printing process. Arseniate of soda (a compound of arsenic acid and soda, containing from 30 to 33 per cent of metallic arsenic) is excessively poisonous; and it is fortunate that the amount required in the calico-printing process is but small when compared with the vast volume of water with which it is mixed. Nevertheless, analysis reveals a very appreciable proportion of arsenic in the effluent water from printworks. Thus, the polluted water flowing from the Kinder Printing Company's works contains, in 100,000 lbs., 0·032 lb. of metallic arsenic, equivalent to 0.042 lb. of arsenious acid or white arsenic. Although this proportion is so small that it would be necessary for an individual to drink no less than 138 gallons of the water in order to imbibe a fatal dose, yet it cannot but be considered undesirable that our rivers should thus become contaminated with such a poisonous ingredient."

The pollution by chemical works is described in the following manner:—

"The chief chemical works carried on in the basins of the Mersey and Ribble are devoted to the manufacture of soda alkali, soap, colours, and oxalic acid. The waste products are alkali waste, dilute muriatic acid (containing a considerable proportion of arsenic), burnt pyrites, chloride of manganese (containing arsenic), and chloride of calcium.

"The alkali waste is not thrown into the neighbouring river or stream, but it is stacked in enormous heaps, from which there drains a liquid containing much sulphuret of calcium in solution, and possessing an odour like that of putrid eggs.

"The burnt pyrites was formerly got rid of as rubbish, but it is now utilised, having been found to be of value as a source of copper.

"The dilute muriatic acid is, as a rule, run into the nearest stream or canal. Messrs. Crossfield, Brothers, and Co., return, as the amount of weak muriatic acid thus run away, 500,000 gallons annually (sp. gr., 1·005), which would contain about 1 per cent of real acid. Mr. A. E. Fletcher, one of the sub-inspectors under the Alkali Act, estimates the amount of free acid thus annually run to waste in the United Kingdom at 111,400 tons of real acid, or 371,133 tons of commercial liquid muriatic acid of 30 per cent strength. This is 45·5 per cent of the total quantity made.

"The chloride of manganese, though containing a valuable material, has not hitherto been utilised to any appreciable extent, and is consequently discharged into the nearest stream. Mr. Fletcher informs us that 54,000 tons of black oxide of manganese are annually consumed in the United Kingdom. Nearly the whole of this finds its way into the rivers as chloride of manganese, 57,500 tons of real muriatic acid being partly combined and partly mixed with it. According to the return of Messrs. Crossfield, Brothers, and Co., whose works are situated on the Saukey Canal, at St. Helen's, a single alkali work thus turns out, annually, as much as 1060 tons of manganese in the condition of chloride.

"The solution of sulphuret of calcium draining from the heaps of alkali waste meets, in the adjacent river, with the two waste products just mentioned, and undergoes, in contact with the dilute muriatic acid and acid chloride of manganese, a very unpleasant reaction, in which large quantities of sulphuretted hydrogen are given off into the surrounding atmosphere; some sulphur and sulphuret of arsenic are thrown into suspension as a fine mud, and the solution of sulphuret of calcium is transformed into a comparatively innocuous one of chloride of calcium. The chloride of manganese also remains in solution, and the stream continues strongly acid.

"The worst case of river pollution from alkali works that we have met with occurs in the Sankey Brook, which receives the waste products from the St. Helen's alkali works. Between St. Helen's and Warrington, the exceedingly offensive smell of this brook can be perceived at a distance of from one to two miles from its banks. When the wind blows from the west, it always unpleasantly surprises the passengers on the London and North-Western Railway between Warrington and Kenyon Junction. Leaving injury to health out of the question, it is no exaggeration to say that this brook renders the country within two miles of its banks uninhabitable, except under a penalty of so much discomfort as few would be prevailed upon to endure."

"The results of the analysis of the pollutions from alkali works are almost entirely of a mineral character, with much free acid, and, curiously enough, free sulphur, for we read—

"A sample of the mud taken from the Sankey Brook, just before its junction with the Sankey Canal, contained, when dried at 100° C., 22·75 per cent of free sulphur. A sample of sludge that had been recently dredged from the Sankey Canal, near its junction with the Sankey Brook, contained 3·97 per cent of free sulphur after drying at 100° C. When it is remembered that sulphur is worth from £6 to £7 per ton, and that 100 tons of the dried mud of the Sankey Brook contain 22¾ tons, and that nearly as much passes into the

air as sulphuretted hydrogen, some conception may be formed of the vast quantity of valuable, and, as we shall presently show, recoverable material, which is thus thrown away and suffered to pollute both air and water to an intolerable degree."

It is quite impossible that, with the enormous mass of interesting details laid before us in this volume, we should be enabled to give here an exhaustive review; we cannot refrain, however, from noticing one of the curious consequences of the introduction of the use of pyrites instead of sulphur for the manufacture of sulphuric acid—

"Thus sulphur has been gradually, but at length completely, replaced by iron pyrites in the production of sulphuric acid for the alkali manufacture. Unfortunately, however, iron pyrites nearly always contains a notable quantity of arsenic, much of which passes into the sulphuric acid obtained from this material. Dr. R. Angus Smith, Your Majesty's Inspector of Alkali Works, informs us (Vol. II., 'Minutes of Evidence,' part 4), that 400,000 tons of iron pyrites are annually imported into this country for the alkali trade. At a moderate computation, we thus annually import 1600 tons of arsenic, a large proportion of which, there is every reason to believe, now finds its way into our rivers and streams. In the alkali factory, the sulphuric acid is employed to decompose chloride of sodium in a closed furnace. The arsenic is here transformed into chloride of arsenic, which, being volatile, passes off, to a great extent, with muriatic acid gas to the condensing towers, where it is dissolved by water and becomes a constituent of strong liquid muriatic acid, which is afterwards used in the manufacture of bleaching powder; and also of weak muriatic acid, which, as we have already described, is run directly into the nearest watercourse. The disposal, in like manner, of the arsenic in the strong muriatic acid is only postponed; it ultimately finds its way into the rivers as waste chloride of manganese liquor. But to return to the non-volatile product of the action of sulphuric acid upon chloride of sodium, technically called 'salt-cake,' which still retains a certain small proportion of the arsenic originally present in the sulphuric acid. This salt-cake is afterwards mixed with crushed chalk, or limestone and coal-dust; and the mixture is heated to incipient fusion in a reverberatory furnace. Here some of the arsenic must volatilise—indeed it might be expected that the whole of it would do so, did not the sequel prove this not to be the case; moreover, the coal-dust, which also contains arsenic, probably more than compensates for the loss. The product of this operation is termed 'black-ash.' It is afterwards lixiviated with water, and the lixivium, being evaporated to dryness, yields soda-ash. In some factories, the crystalline granules of soda-ash, as they are deposited during evaporation, are fished out of the boiling liquor, and are afterwards sent into the market as ash of first quality. The residual liquor being evaporated to dryness constitutes ash of the lowest quality, which will contain the largest proportion of arsenic, whilst the first quality ash may be comparatively or entirely free from the poison. In a series of samples kindly supplied to us from a large chemical work, we have clearly traced the arsenic from the original iron pyrites, through the different products just enumerated, up to this point. A certain proportion of soda-ash is re-dissolved in water, and then allowed slowly to crystallise; the soda crystals thus obtained are a true carbonate of soda, and constitute the common 'washing soda' of the shops. We have examined nine samples of washing soda obtained from as many oil shops, and found that only two of them contained the poisonous metal. The bicarbonate of soda, again, of the druggist is made from the soda crystals just mentioned. Two samples of this material were examined and found to be entirely free from arsenic.

"Soda-ash is extensively used in all bleaching and scouring operations; and thus arsenic is unconsciously introduced into a vast number of factories, as, for instance, that of Messrs. Bright and Co., at Rochdale. It is employed in the manufacture of soap, but is for the most part got rid of in the spent lye of soap works, a specimen of which contained 0·325 part of arsenic in 100,000 parts; hence, of six samples of soap which we have examined, only two contained arsenic, and in but very minute quantity. As soap and washing soda are used in most households, the poisonous metal is liable to gain admission into many dwellings; it is carried by the slops into the sewers, and, in London, is afterwards found in the sewage at Barking to the extent of 0·004 in 100,000 parts.

"We are by no means disposed to take an alarmist view of this wide distribution of arsenic amongst the community; indeed, as we find it to be contained in very appreciable quantity in the rain which falls in London, being derived in this case from coal smoke, it is, doubtless, present in the rain-water of all our large towns, and consequently cannot be entirely excluded from rivers; nevertheless, its unnecessary introduction cannot but be regarded as, on many grounds, undesirable; and we believe that, so far as soda-ash and its derivatives are concerned, it might be easily prevented by submitting the 'salt-cake' and 'black-ash' to a somewhat more prolonged roasting, by which the arsenic, now partially driven off, would be completely expelled. We trust that, when the presence of this impurity becomes known to alkali manufacturers, they will direct their attention to remedy the evil, introduced into their processes chiefly by the substitution of iron pyrites for sulphur."

Turning our attention now to the remedies proposed, we find the following in respect of the purification of sewage, treated under the three heads of—Treatment with Chemicals; Filtration; and Irrigation. The first of these is alluded to as follows:—

"*Purification of Sewage by Chemical Agents.*—The valuable constituents of sewage present to the chemist a mine of wealth, which, despite so many failures, has constantly stimulated him to renewed efforts for their extraction in a portable, and consequently marketable, form.

"The chief valuable ingredients of sewage are, first, the different forms of combined nitrogen; and, second, phosphoric acid. The money-value of these constituents *dissolved* in 100 tons of average sewage is about 15s., whilst the *suspended matters* contain only about 2s. worth of them.

"There is but little difficulty in extracting the suspended matters by filtration, but, as these do not contain quite one-seventh of the total valuable constituents, the process, though simple, has never been remunerative; and, inasmuch as it still leaves much putrescible organic matter in solution, the mere extraction of the suspended matters of sewage, although doubtless tending to mitigate nuisance, does not produce any substantial diminution of the polluting quality of the liquid. The operations of the chemist have therefore been directed chiefly to the soluble constituents of sewage; and have had for their object, either the precipitation in a solid form of the valuable, but offensive, ingredients, so as to convert them into portable manure, or, secondly, the rendering them inoffensive by the action of disinfectants. Although these operations have not been altogether unsuccessful, they have hitherto entirely failed in purifying average sewage to such an extent as to render it admissible into running water. We have formed this opinion both from observations of the polluting effect of such chemically-purified sewage upon the streams into which it was admitted, and from the amount of putrescible organic matter revealed by the chemical analysis of the sewage after treatment.

"The following is a description of those processes belonging to the chemical category which we have witnessed in operation:—

"(*a*). *Treatment with Lime.*—This process was doubtless first suggested by the ingenious operation devised by the late Dr. Clarke, of Aberdeen, for softening certain hard waters. It has been applied to sewage upon an extensive scale, at Tottenham, for the manufacture of 'Tottenham sewage guano;' at Blackburn, and especially at Leicester, in the production of the so-called 'Leicester bricks' (the name under which the manure was sold). In all these

places, the plan has been a conspicuous failure, whether as regards the manufacture of valuable manure, or the purification of the offensive liquid.

"We have witnessed the process at Blackburn, and on two occasions at Leicester, where it is still used, the machinery employed at the latter place being very perfect and efficient.

"At both places the method obviously failed in the purification of the sewage to such an extent as to render it admissible into a river. At Blackburn especially the river below the outlet of the limed sewage was in a most offensive condition of putrefaction, our note made at the time of our visit being as follows:—'Horribly offensive, turbid, blackish stream, disengaging most offensive gases, with black masses of putrid mud floating on the surface.'

"The operation is exceedingly simple, and, as carried out at Leicester, consists in mixing with the sewage, as it arrives at the works, a certain proportion of milk of lime. The mixture is then violently agitated by appropriate machinery on its way to large reservoirs of subsidence, in which a copious deposit of highly-putrescible mud takes place, whilst the supernatant liquid flows off in a comparatively clear, though still somewhat milky, condition. The floors of the reservoirs of subsidence slope from two opposite sides towards the centre, where there is a gutter, from which a Jacob's-ladder elevates the slush into a shoot, through which it is conveyed to pits, where it slowly dries, partly by evaporation and partly by soakage into the surrounding soil.

"(*b*). *Treatment by Sillar's Patent or "A.B.C." Process.*—The specification of this process is given by the patentees, Messrs. W. C. and R. G. Sillar and W. G. Wigner, as follows:—

"'We add to the sewage to be purified a mixture consisting of the following ingredients:—Alum; blood; clay; magnesia or one of its compounds (by preference the carbonate or the sulphate); manganate of potash or other compound of manganese; burnt clay, otherwise known as ballast; chloride of sodium; animal charcoal; vegetable charcoal; and magnesian limestone. Of these substances, the manganese compound, the burnt clay, chloride of sodium, and magnesian limestone may be omitted; and it is not essential that both animal and vegetable charcoal should be used. If any of the ingredients named should from any cause be present in sufficient quantity in the sewage, it may of course be omitted from the mixture. The proportions in which the ingredients are to be used vary according to the nature of the sewage to be purified—as, for instance, if a large proportion of urine is present, we increase the proportion of clay; if the sewage is much diluted, we slightly increase the proportion of alum and blood; if it contains a large proportion of street-refuse, we decrease the proportion of clay.

"'For ordinary sewage, the following proportions have answered well:—

Alum	600	parts
Blood	1	"
Clay	1900	"
Magnesia	5	"
Manganate of potash	10	"
Burnt clay	25	"
Chloride of sodium	10	"
Animal charcoal	15	"
Vegetable charcoal	20	"
Magnesian limestone	2	"

"'These substances are mixed together, and added to the sewage to be purified until a further addition produces no further precipitate. The quantity required will be about 4 lbs. of the mixture to 1000 gallons of sewage. In many cases, it is preferable to mix the above compound with a small quantity of water, and add it in a liquid state to the sewage. The sewage must then be thoroughly mixed with the compound, and allowed to flow into settling-tanks. The greater part of the organic and other impurities will be immediately separated in the form of large flakes, which rapidly fall to the bottom, leaving the supernatant water clear and inodorous, or nearly so. The water may then be allowed to flow away into a river, or be disposed of in any other way, and the sediment or mud allowed to accumulate at the bottom of the tank. In some cases, it is preferable to add the compound of manganese to the water after the sediment produced by the other ingredients has been allowed to subside. The sediment will be found to possess the power of precipitating a further quantity of sewage; it must therefore be pumped or otherwise taken from the tank, and mixed with fresh sewage, the sediment being allowed to subside in the same way as before. The sediment may be used five or six times over in this way. When the sediment no longer possesses the power of precipitating the impurities in the sewage, it must be removed from the tank, and allowed to dry. When partially dry, a small quantity of acid (by preference sulphuric acid) may be mixed with it, which will retain all the ammonia in a soluble form. When dried, the sediment will be a valuable manure.'"

Speaking of this process the Commissioners say that, "Notwithstanding the loss of nitrogenous organic matter in the process of deodorisation, the 'A.B.C.' method of treatment still yields a solid manure of much greater value than that obtained by the lime process—a circumstance which is explained, to a great extent, by the acidity of the mud from the former process, and the alkalinity of that from the latter. The lime mud thus loses ammonia in drying, whilst the other, especially if still further acidified, cannot suffer this loss."

The analysis of the mud shows that "In the three valuable constituents of manure, viz., in ammonia, in other forms of combined nitrogen, and in phosphoric acid, the manure obtained by Sillar's process is greatly superior to that resulting from the treatment with lime. Unfortunately, some doubt is thrown upon the source of the increased amount of phosphoric acid present in the manure obtained by the former process, because bone-black, in, to us, unknown quantity, entered into the composition of the precipitating material used, and thus an uncertain amount of phosphoric acid was added to that which was actually derived from the sewage."

The results of their experiments on the Sillar and lime processes are summarised as follows:—

"1. The 'Sillar' and lime processes remove to a great and nearly equal extent the suspended matters contained in sewage.

"2. Sillar's process increases the amount of dissolved solid matters in sewage, but reduces the quantity of putrescible organic matter. The lime process reduces both the amount of dissolved solid substances and the quantity of putrescible organic matter; the reduction of the last being about the same as that effected by Sillar's process, viz., rather more than one-half.

"3. Both processes fail in purifying sewage to such an extent as to render it admissible into running water."

"4. For the manufacture of solid manure from sewage, Sillar's process is greatly superior to the method of treatment by lime, although it fails to extract from the liquid more than a very small fraction of its valuable constituents."

The treatment by lime and chloride of iron is described as follows:—

"At Northampton, this process is applied to the sewage of 40,000 people. 4400 houses are here connected with the drains, and 2800 are undrained. The excellent and constant water supply of 600,000 gallons daily, or 15 gallons per head, is derived chiefly from deep wells in the oolite. The sewage works are situated about half a mile from the town. Each million gallons of sewage is here mixed with 12 bushels of lime and about 6 gallons of chloride of iron (in hot weather more; in cold weather less). The lime is added first, and then the chloride of iron. The defecated sewage is afterwards submitted to upward filtration through a stratum of calcined iron-ore 8 inches thick; but we consider that, beyond the separation of suspended matters, which would be equally effected by subsidence, this latter operation is nearly useless. The effluent sewage, after a flow of 1½ miles

through a culvert, in which it becomes mixed with about one-sixth of its volume of spring water, is discharged into the river Nen, in a nearly clear and apparently innocuous condition. We examined the stream for about one-third of a mile below the outfall, and could perceive no sewer-fungus or other sign of sewage pollution. Nevertheless, analysis shows that the sewage discharged into the stream still contains in solution a large amount of putrescible organic matter; but the putrescence of this matter was doubtless delayed, by the chloride of iron used in the treatment, until the stream had flowed beyond the point where we examined it. It is well known that chloride of iron possesses this property in a very remarkable degree;* but the putrefaction of the disinfected sewage is only delayed, and not ultimately prevented. In fact, the river Nen does eventually become putrid in consequence of the discharge into it of the Northampton sewage; and an injunction has been granted by the Court of Chancery restraining the Improvement Commissioners from discharging the sewage of the town into the river after June 1st, 1870.

"The chloride of iron in solution is manufactured on the premises at a cost of £6 per ton. A sample of it which we brought away with us contained, in 100,000 parts:—

Iron as perchloride	4413·7
" protochloride	9124·3
Total iron	13538·0

" *Treatment with Crude Sulphate of Alumina, and subsequent Filtration through Coke.*—This process, which is known as Bird's, is carried out at Stroud, in Gloucestershire. From 150,000 to 200,000 gallons of sewage are daily treated with 6 cwts. of pulverised clay, to which 120 lbs. of sulphuric acid have been added some days previously. The sewage is made to turn a small water-wheel which regulates the delivery from a hopper of the sulphated clay or crude sulphate of alumina, which falls into the stream of sewage on its passage to a settling-tank, whence it flows under a second hopper, from which it receives a second dose of the sulphated clay. Thence it flows into a depositing-tank, and afterwards through three coke filters. The coke is renewed in the first filter every fortnight, and in the last every month. The foul coke is burnt under the boiler."

The condensed results of purification of sewage are expressed, as far as chemical processes are concerned, in the following brief tabulated form:—

Chemical processes.	Average percentage of dissolved organic pollution removed. Organic carbon.	Organic nitrogen.	Average percentage of suspended organic pollution removed.
Best result	50·1	65·8	100·0
Worst result	3·4	—	59·6
Average result	28·4	36·6	89·8

The sections on the purification of rivers from the liquid refuse from manufactories, and that on water-supply, however interesting, are of too local an interest, in this instance, to call for condensation or for an abbreviated account here. The recommendations of the Commissioners are worthy of our notice, and we therefore quote these in full, with the observation, however, that nobody acquainted with what is really meant by, and included in, the term *police*, taken in the scientific sense, can fail to see that the want of sufficient centralisation and power of control given to the Secretary of State for the Home Department, as *ministre de l'intérieur* over all municipal and local authorities, where and whatsoever they be, is at the bottom of the state of matters, caused by ignorant neglect, as well as foul selfishness, and described in these pages. What is absolutely wanted is a strongly and well organised *administration de la sûreté et de la salubrité publique*. As understood and carried out abroad, *Salus populi suprema lex esto*.

" 1. That the casting of any solid matters, of whatever kind, into rivers and running waters, or the placing of solid refuse in such positions on the banks of rivers as to render it liable to be washed away by floods, be absolutely prohibited under adequate penalties; and that any act passed for this purpose be made to take effect immediately.

" 2. That the discharge of any polluting liquids, such as those defined in the conclusions to this Report, into any river or stream, from any sewer or other outlet, reservoir, tank, or vat, be prohibited under adequate penalties; but that, after the passing of any act prohibiting the admission of polluting liquids into running water, a reasonable time be allowed to corporations, local boards, manufacturers, and others, for the execution of the necessary works for purification.

" 3. That all rivers and streams in England be placed under the superintendence of a central authority or board, to be composed of not more than three persons, who shall be duly qualified to deal with all questions connected with the pollution of water and with water-supply.

" 4. That it be the duty of this board to see that all enactments relating to the use or abuse of running water be duly enforced; and that, for this purpose, power be given to it to inspect manufactories, reservoirs, sewerage, and other similar works, and to cause to be constructed, at the expense of the owners of the same, whether corporate or private, any necessary purifying-apparatus, in case the said owners neglect or refuse to provide such apparatus for themselves.

" 5. That, subject to proper regulations to prevent abuse, additional powers be given to corporations, local boards, manufacturers, and others, to take land compulsorily, under 'Provisional Order,' for the purpose of cleansing sewage or other foul liquids, either by irrigation, filtration, or otherwise, and to obtain, if required, easements for the construction of culverts and outfalls for drainage through private property, making compensation only for damage actually done, reserving, however, to the owner the right at any time afterwards, if he could show further damage, to have further compensation.

" 6. That it be the duty of the central board to exercise a surveillance over both the quality and quantity of the water-supply of towns; to carefully guard domestic supply from contamination, or, if it be already contaminated, to ascertain the source or sources of injury, and to cause the same to be removed.

" 7. That it be the duty of this central board to investigate all schemes for water-supply; and also all proposals for public works connected with river-conservancy, whether initiated by local authorities or by any principal conservancy board of a river-basin either now in existence or to be hereafter constituted; and to report thereon to one of Your Majesty's Principal Secretaries of State."

Our space forbids us to make further extracts from this full and comprehensive report, but we cordially recommend its perusal to all interested in the question. As stated in the prefatory remarks, the report refers to the subject of river conservancy generally as well as to the condition of the particular river basins to which it is professedly confined. The Commission could not have included a more able and earnest worker than Dr. Frankland, and our thanks are due to him and his brother Commissioners, Sir W. J. Denison and Mr. J. C. Morton, for the great scientific skill they have brought to bear on this difficult subject.

Proceedings of the American Pharmaceutical Association at the Seventeenth Annual Meeting, held in Chicago, Ill., September, 1869 Philadelphia. 1869.

This well got up volume, containing nearly 500 pages, is a most convincing proof of the flourishing, and, at the same time, highly scientific and efficient, *status* of the pharmaceutical branch of the medical profession in the United States, and the confirmation, also, of the truth of the "E Pluribus Unum," in another and not less highly creditable sense.

* Report on the Deodorisation of Sewage, by Hofmann and Frankland, presented to the Metropolitan Board of Works, August 12th, 1859.

Since it is entirely out of the question to give more than a very superficial account of the contents of this work, we quote from the contents the following particulars:—As might be expected from the title, a very full account is given of the meetings held during six sittings. Next follow Reports of Committees; that of the Committee on the Progress of Pharmacy being, indeed, a masterpiece of its kind, including as it does pharmacognosy, pharmaceutical chemistry, and pharmaceutical legislation. We next meet an excellent report of the Committee of Specimens, followed by a Report on the Pharmacopœia. Among the special reports, we notice those on Pharmaceutical Glass-Ware, and on Corks (this is a very interesting paper, full of generally-useful information). Among the volunteer reports and essays, we notice the United States Cabinet of Practical Geology and Mining; while we regret that we cannot enter into particulars we must not omit to call attention to the short paragraph on this subject in our issue of February 18th last (Chemical News, vol. xxi., p. 83; *Am. Repr., April*, '70, *page* 218) Under the title of "The St. Louis Medical Spring," by Samuel S. Garrigues, we meet with the following analysis of a mineral water accidentallydiscovered at a depth of 200 feet below the surface, while borings were made for finding salt at St. Louis, Gratiot Co., Mich.:—Temperature of water, 50° F.; constant sp. gr., 1·011. Total mineral matter in a gallon, in grains, 270·60, viz.,—Sulphate of lime, 66·50; silicate of lime, 6·72; chlorine (curiously enough) only a trace; bicarbonate of soda, 106·40; bicarbonate of lime, 69·40; bicarbonate of magnesia, 17·50; bicarbonate of iron, 1·20; free silica, 2·88; organic matter and loss, 2·00;—total constituents, 272·60; free carbonic acid in gallon, 6·21 (*queritur*, what—grains or cubic inches?). This water is stated to carry a current of electricity, or, perhaps, magnetism (time did not allow to specify which). Under the heading of "Michigan Salt," by the same author, we meet with the two following analyses of samples of Saginaw salts, percentically and respectively composed of—Chloride of sodium, 93·892 and 95·327; chloride of calcium, 1·446 and 0·699; chloride of magnesium, 0·771 and 0·313; moisture, 3·430 and 3·308; sulphate of lime, 0·461 and 0·363. It need hardly be said that the volume before us contains a large amount of highly-interesting well-digested and collected information in regard to pharmacy in all its relations, but space forbids us to enter into further details.

CORRESPONDENCE.

Action of Iodine on Hyposulphite.

To the Editor of the Chemical News.

Sir,—In reply to the letter of Mr. E. Sherer in the Chemical News (vol. xxi., p. 141; *Am. Repr., May*, '70, *page* 273) I have to say that my experiments on the action of iodine and hyposulphite solutions were performed immediately after his paper, "On the Estimation of Manganese Ores," was read before the Newcastle Chemical Society (Nov. 25th, 1869), and were sent to that Society before the appearance of his further note on the subject in the Chemical News (vol. xxi., p. 48; *Am. Repr., March*, '70, *page* 176). His statement that the increased amount of iodine formed on allowing the liquid obtained in Bunsen's process to stand some hours "was caused by the conversion of iodine into hydriodic acid" (*sic*), did not appear in the original paper read in Newcastle.—I am, &c.,

G. R. A. Wright.

Washington Chemical Works, Durham,
April 2, 1870.

Manufacture of Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—I was just going to answer the objections which Mr Gibbins made, in the Chemical News (vol. xxi., p. 132; *Am. Repr., May*, '70, *page* 292), to my proposed improvement in the manufacture of sulphuric acid, when I saw the letter of Mr. P. Spence, stating that he has already tried, in his large chemical works, some experiments on the subject. Mr. P. Spence answering, in every respect to my full satisfaction, the objections of Mr. Gibbins, I have only few words to add.

For the last three years, a great number of vitriol chambers here work at a high specific gravity; but they are arranged different from those of Mr. Spence. The sulphurous acid comes in contact with the nitric acid in a little chamber of a capacity of scarcely 100 cubic metres (called in France, *tambour*); it is in this chamber that the action of the two acids takes place. No aqueous vapour, or very little, is introduced in this chamber, and the vitriol manufactured is kept at a specific gravity of 1·715. When this chamber is first set at work, there is no doubt that a layer of sulphate of lead is formed; but, as no aqueous vapour is introduced, it remains on the lead, and protects it against a further action. I have cut out a piece of lead of 10 c.c. after a trial of three years, and I found that it weighed as much as an equal piece of lead of a chamber which, during the same lapse of time, worked otherwise than by my system.

Mr. Gibbins is quite right in saying that the vitriol manufactured under these circumstances is so charged with nitrous acid that, on concentration, a great loss of nitric acid is caused; but, as Mr. P. Spence explains very well, this acid is not employed directly, but is run into a series of different chambers, where it loses so completely all nitric acid, by the action of sulphurous acid, that the vitriol which is run off no longer gives a colouration on addition of sulphate of iron.—I am, &c.,

P. W. Hofmann.

Société Anonyme des Ancieanes Salines
Domaniales de l'Est.
Etablissements de Dieuze (Meurthe),
April 4th, 1870.

Manufacture of Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—I think it due to Mr. Hofmann, while acknowledging him as the originator of what I expect will become an immense improvement in the manufacture of sulphuric acid, and expressing my thanks for his liberality in freely giving his invention to the chemical world, to give him, and all who feel interested in the matter, my experience in working out Mr. Hofmann's plan with what I still consider my slight improvements in the *modus operandi*.

I am under the necessity of keeping all my chambers at work while gradually making my arrangements for the new mode, as I require the equivalent of 90 to 100 tons of acid of 1·845 out of them weekly; I am, therefore, only partially at work on the new plan, but so far with most encouraging success.

When I commenced operations my consumption of nitrate of soda was exactly 4 tons 2 cwts. weekly. I have reduced down to 3 tons, and my acid is still of good colour, showing sufficient nitre, and last week my production was rather over my average.

I am now preparing for throwing all the SO_2 from my whole series of furnaces into No. 1, and shall then work Nos. 2 and 3, as I am now doing, at 1·715, and without steam; and all the acid from these two chambers, loaded with nitrous fumes, goes back into No. 1, where, mixing with the hot acid of about 1·5, produced by No. 1, into which steam is thrown in large volume, the nitrous acid is evolved and again becomes available, and so is brought back to its work by a process which makes it theoretically almost impossible for it to escape, although practically there must always be a considerable loss. This regular return of the nitrous acid to the first chamber, Mr. Hofmann will, I think, allow to be an improvement on his theory.

I think I see my way to working with 2 tons nitrate instead of 4 tons 2 cwts.—I am, &c.,

P. Spence.

Manufacture of Sulphuric Acid.

To the Editor of the Chemical News.

Sir,—I have been much interested in the discussion on the above subject, which has appeared in your journal, but I think there is some want of precision in some of the statements that have been made.

In the Chemical News, vol. xxi., p. 106 (*Am. Repr., May, '70, page* 280), there appeared a translated extract from a paper of Mr. Hofmann's containing the statement:—"By this contrivance, it is possible to manufacture sulphuric acid with a consumption of only 1 lb. of nitric acid for 100 lbs. of sulphur burnt." My attention was arrested by this statement, but on enquiry I was informed by an excellent German chemist who had access to the original paper, that Dr. Hofmann merely claimed to manufacture an equal product of sulphuric acid with *one per cent less nitric acid than had formerly been in general use.* This would change the entire aspect of the question, for I know very well that British manufacturers profess to procure an adequate return (say, from 286—294 H_2SO_4, specific gravity 1·846, from 100 of S.) of acid, while they vary in the percentage of nitrate of soda which they consume in the process from 2·5 up to 8 or 9. The quantity of nitrate used very much depends on the chamber room, regularity of working, supply of steam and air, &c., and on this account I am strongly of opinion that, valuable as Dr. Hofmann's suggestion may be (and I intend to give it a fair trial, extending over many weeks unless deterred by its decided failure), I cannot regard it as more than a small item in a very complex question.

From the few data given by Mr. Spence, we may arrive at an approximation to the results obtained by him; and, if my calculations are correct, I think it will appear that Mr. Spence has not yet attained all that he might wish for. Mr. Spence tells us that he requires about 100 tons of acid, sp. gr. 1 845, per week, and that, in making this quantity of acid, he expended 4 tons 2 cwts. of nitrate of soda. Now, if we assume that the production of acid is adequate (294 from 100 S), then Mr. Spence was using, before his late change in working, 12·06 to 100 of sulphur. If, on the other hand, we assume that Mr. Spence, in common with many manufacturers, expends only 8 per cent of nitrate in the case of sulphur, or 4·5 per cent to Mason's ore, then his kilns should consume 51 tons of sulphur, producing 145—150 tons of acid, sp. gr. 1·845, or, if he burn pyrites, 91 tons of Mason's ore, giving 125 tons of acid. The above data are founded on the quantities quoted by Mr. Spence, and are as precise as the absence of the absolute weights used and obtained will permit; but they demonstrate that it is perfectly possible to obtain an improvement, and that a very considerable one, if my calculations respecting Mr. Spence's working be correct. Every manufacturer of oil of vitriol will bear out my experience, which is this—that the economical production of vitriol is a problem which every man must solve in a great part for himself, and that it depends on a variety of conditions, not exactly the same in many instances; but they may be classed into the chemical, the physical, the practical, and the commercial. The first and second of these are of paramount importance, and have not been sufficiently attended to, or all might arrive at a perfection almost complete; the latter involve the consideration of perfection of apparatus, skilled attention to working, and the varying conditions which regulate supply according to price and demand. In conclusion, I may say that I agree with Mr. Gibbins that there is much difficulty in making acid which has absorbed nitrous compounds give them up completely, as I have detected them in the acid, although in much diminished quantity, after dilution, agitation, and boiling.

I fear I have trespassed already too much on your valuable space, so that I must conclude.—I am, &c.,

David Basil Hewett, B.A., T.C.D.

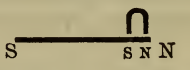
Manchester, April 25th, 1870.

Magnetic Phenomena.

To the Editor of the Chemical News.

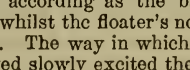
Sir,—Having recently met with some curious results in the shape of magnetic phenomena, I take the liberty of transmitting you an account of them. Having magnetised an ordinary needle by means of a small horseshoe (1 inch across at the poles), I floated it on some water, when it arranged itself in the magnetic meridian and exhibited the usual attraction and repulsion to a small bar magnet. The horseshoe was now rubbed to and fro upon the nothern half of this bar (which was four inches long, and about the thickness of a lucifer) for several times from position *a*, in which the horseshoe's south occupies the bar's centre, and its north is intermediate between that of the bar and its centre to position *b*, in which the horseshoe's and bar's north are both in contact, as shown in the annexed diagram,

Upon trial it was found that both poles of the bar were now south, attracting the north of the floating needle and repelling its south. A repetition of the experiment on the southern half of a similar bar resulted in two north poles. Another magnetic bar being than obtained, the horseshoe was left in position (*b*) for ten seconds,



when the extremity, which had been thus exposed, was found to repulse the needle's south when presented to it within the space of one-eighth of an inch, and to attract its north when placed in like proximity to it, but, beyond this distance, the reverse phenomena was exhibited the same as before exposure. After exposing in the same way for another ten seconds, the equilibrial points were found to have become situated farther from the needle's extremities, and other repetitions gradually removed them to the distance of half an inch, the south of the floater then always retiring to that distance from the bar's affected extremity or approaching thereto, according as the bar was presented within or beyond it; whilst the floater's north acted in manner precisely reverse. The way in which the south followed the bar when moved slowly excited the impression of its being in some manner moored to it.

Still further exposure to the horseshoe did not produce any further change until it was made at a position nearer the bar's centre: thus—

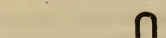


upon which the equilibrial points separated to greater distances, and, at length, had retired further than the bar's magnetism was perceptible, so that its north pole now appeared an ordinary south, as in the first of our experiments. The result of that experiment being thus obtained in successive steps.

Further experiment yielded analogous results with the bar's other pole, and it was found that contact with the horseshoe in a reversed position always neutralised the effect of contact in the other.

The following experiment was then made with the floating needle:—

Its north was exposed to the horseshoe's north for a short interval as annexed, but not permitted to approach it nearer than the sixteenth of an inch.



Upon refloating, it was found to have lost some of its directive power (shown by its moving more slowly to the magnetic meridian), and by cautious repetition of similar exposure this power was at length totally destroyed, and a floating needle obtained which remained quiescent in whatever position was given to it, and exhibiting two south poles.

To assist in producing these results it may be observed that should the horseshoe's north be applied too long to the needle's extremity, this extremity will become more powerfully south than the other, in which case the needle will not fail to arrange itself as usual. This, however, may be counteracted by a momentary exposure to the horseshoe's south, so that the experimenter will be enabled to bring about the conditions sought in all cases very readily by such alternation.

In conclusion, it may be remarked, that needles with similar poles at both extremities always exhibit the opposite magnetism somewhere within their length, and that the double poled results appear to be permanent.—I am, &c.,

EDWARD PORTER, jun.

478, Crown Street, Sydney.

P.S. I enclose a needle, which was prepared in January, 1869, exhibiting two south poles, as may be proved by floating it and applying a magnetised bar near either extremity, when either will be found to recede from a south and approach a north pole. Care must be taken to prevent the needle's *contact* with any magnet lest its properties be altered.

MISCELLANEOUS.

Female Students of Chemistry.—Yesterday, at the Chemistry Class in the University, the results of the examinations held in the course of the session were announced by Professor Crum Brown, who stated that 13 of the students had attained first-class honours. Their numbers stood as follows:—87, 86, 85, 84, 82, 81, 80, 80, 78, 76, 75, 75, 75. The third name on this list is that of Miss Mary Edith Pechey (85); the tenth that of Miss Sophia Jex Blake (76)—two of the six lady students who, in accordance with the decision of the University authorities at the beginning of the session, had been admitted to study in the medical classes. To the four students whose names stand highest in the Chemistry Class for the session the Hope scholarships fall to be awarded, two of which entitle the holder to attend at the laboratory for the winter and summer sessions, and two for six months only. Dr. Crum Brown, however, announced yesterday that the scholarships would be given, not to the four students highest on the list, but to Messrs. (1) Wilson, (2) Alston, (4) Young, and (5) M'Queen—Miss Pechey's name, which stood third, being thus dropped out, though it was at the same time announced that Miss Pechey was entitled to, and would receive, one of five medals awarded to the five highest students of the session. This decision, which is not, we understand, likely to pass unchallenged, seems the more ungracious when the origin of the scholarships—of what seems her clear right to one of which Miss Pechey has thus been arbitrarily deprived—is considered. They arose out of the success of a course of lectures given a number of years ago by Dr. Hope, then Professor of Chemistry, to a ladies' class held in the University. Dr. Hope was so much gratified by the popularity of these lectures that, with their proceeds (amounting to about £1,000), he founded the scholarships in question. It is rather remarkable that, on the first occasion on which ladies have had the chance of competing for these scholarships, one of them should have triumphantly entitled herself by her position in the class, to this honour and reward—still more remarkable, surely, that she should not receive it. The facts as to Miss Pechey's eminence are even stronger than they appear as stated above; for we understand that both the gentlemen whose names precede hers had attended a previous course of chemistry. So that Miss Pechey's position is absolutely the highest of all the students who may be classed as students of the year, the whole number of the class being about 236, inclusive of the six ladies.—*The Scotsman*, March 29th.

Andersonian University.—We believe that Dr. Clark, assistant to the late Dr. Penny, who delivered the remainder of the winter course of lectures on Chemistry after that gentleman's death, has been appointed to deliver the summer course; pending permanent arrangements consequent upon the proposal of the President, Mr. Young, to endow a chair of technical chemistry.

Opera-House Dirt.—The dust obtained from the places of amusement in New York has recently been analysed by the scientific officers of the Metropolitan Board of Health. Over one hundred specimens of the particles floating in the air, and falling as dust, were collected on plates of glass, and were examined under the microscope. The proportions of the different ingredients varied, but the same substances were found in all the specimens. The composition of the matter subjected to the microscope was as follows:—"The dust of the streets in its finer or coarser particles, according to the height at which it had been collected, with a large proportion of organic elements; particles of sand, quartz, and feldspar; of carbon, from coal-dust and lampblack; fibres of wool and cotton of various tints; epidermic scales; granules of starch of wheat, mainly the tissues of plants; the epidermic tissue, recognised by the stomata or breathing pores; vegetable ducts and fibres, with spiral markings; vegetable hairs or down, either single or in tufts of four or eight, and of great variety, and three distinct kinds of pollens. Fungi were abundant from mere micrococcus granules to filaments of mould. When water was added to a portion of dust from whatever source, and exposed in a test tube to sunlight or heat for a few hours, vibriones and bacteria made their appearance, and the fungous elements sprouted and multiplied, showing that they maintained their vitality, and proving that the germs of fermentation and putrefaction are very widely diffused."—*Scientific American.*

Quality of the Gas Supplied to the Metropolis.—Dr. Letheby, the Chief Gas Examiner appointed by the Board of Trade, has reported to the Corporation of London and the Metropolitan Board of Works the quality of gas supplied to London under the provisions of the "City of London Gas Act, 1868;" and the following are the principal results:—1. *As Regards Illuminating Power.*—This has ranged the case of common gas from 16·70 standard sperm-candles to 17·84, the average of the different companies being as follows:—City Company, 16.95 candles; Chartered, at Leadenhall Street, 17·84 candles, at Gray's Inn Road, 16·70 candles, and at Arundel Street, 17·60 candles; and the Great Central Company, 17·46 candles. The illuminating power of the Cannel gas has been 24·12 candles in the case of the Chartered Company, and 26·09 in that of the City Company. 2. *In Respect of Purity.*—Sulphuretted hydrogen has been always absent from the gas of all the Companies, except on one occasion, when it was accidental. The average amounts of sulphur in other form than sulphuretted hydrogen were as follows:—9·54 grs. per 100 cubic feet of the Cannel gas of the City Company, and 25·82 (or nearly three times as much) in that of the Chartered Company; 14·19 grs. per 100 cubic feet of the Great Central gas; 19·99 grs. in the common gas of the City Company; and 22·47 grs., 24·43 grs., and 29·31 grs. in that of the several stations of the Chartered Company. These results show that the amount of sulphur in the gas of the Chartered Company is largely in excess of that of the City and the Great Central Companies; and considering the mischievous effects of this impurity, it is highly necessary that the proportion of it should be kept down to the smallest amount. Ammonia has been always absent from the City

Company's gas; but it has ranged from 0·86 of a grain per 100 cubic feet to 4·9 grs. in the gas of the Chartered Company, the average for the quarter being 0·86 gr., 1·4 grs., 3·28 grs., and 2·1 grs. in the gas at the several stations of the Chartered Company, and 2·1 grs. per 100 cubic feet of that of the Great Central Company.

Humid Copper Process, Invented by Dr. Sterry Hunt.—The ordinary process for the manufacture of cement-copper consists in the solution of the copper compounds (generally by means of acids) and the precipitation of the metallic copper by the addition of iron. This method is open to two objections. One is the waste of iron, resulting from the fact that, of the iron added, a part remains in solution without precipitating any copper, and another part is itself precipitated with the copper. The other objection is the contamination of the product arising from this precipitation of a portion of the iron with it. The ingenious process of Messrs. Hunt and Douglas obviates these objections by a change in the method of effecting a solution. The preliminary roasting of sulphuretted ores, and the final precipitation with metallic iron, are the same as in the ordinary process; but the chemical reactions of the solution are widely different. The evils we have alluded to arise from the acid solutions employed, and the per-salts of iron contained in them. The peroxide of iron in the bath, whether in combination with sulphuric or muriatic acid, absorbs a portion of the metallic iron, and becomes reduced to protoxide; while a portion of the per-salts falls in a basic, insoluble precipitate. These unstable per salts should, if possible, be avoided. Again, the subchloride of copper contains twice as much copper in proportion to the chlorine as the protochloride. The ordinary precipitation substitutes iron for the copper of the protochloride, making metallic copper and protochloride of iron; but the same iron would suffice to expel 2 equivalents of copper from the dichloride. Thus—

$$Cu\,Cl + Fe = Cu + FeCl$$
$$Cu_2Cl + Fe = 2Cu + FeCl$$

It is evident, therefore, that the more dichloride of copper is present in the solution the less iron will be required for the precipitation. The theoretical amount required for a protochloride solution is, as we have said, 88·3 parts of iron for 100 of copper. The theoretical amount for dichloride is half as much, or 44·1 parts of iron. For mixtures of the two, the proportion of iron required by theory would vary between these two limits, according to the proportions of the proto- and di-chloride of copper. But this desirable dichloride of copper is insoluble in water, and in the ordinary process its presence would be troublesome. The bath employed on the new process, however, permits its formation, and holds it in solution. This bath is a solution of neutral protochloride of iron, with a certain proportion of salt. The former acts upon the oxidised copper, producing a mixture of dichloride and protochloride, and precipitating at once peroxide of iron. The salt holds the copper salts in solution, and the liquid is drawn off from the insoluble residuum. From this liquid, by the addition of metallic iron, the copper is precipitated. By this means, all absorption or precipitation of iron in the last operation is avoided, and, at the same time, the theoretically-necessary quantity is reduced, since a large portion of the copper (about two-thirds) is dichloride. It is found easy in practice to produce 100 lbs. of pure cement-copper by the use of about 60 lbs. of iron.—*Engineering and Mining Journal*, U.S.A.

Explosion of Fulminating Gold.—We are indebted to Mr. William A. Sweet for the following details of a curious explosion which lately occurred at a jeweller's establishment in Syracuse. A quantity of gold scrap had been dissolved in nitro-muriatic acid and precipitated by ammonia. The entire material being then placed over a register to evaporate was left there, in an earthern jar, until dried. It was then removed, and when cool, the operator, who had evidently not studied the chemistry of gold, proceeded to scrape out the dry precipitate into a sheet of paper; a serious detonation soon occurred, and pieces of the jar were driven through a thick plate-glass screen, making clear holes, without cracks, so high was their velocity. We are not told what became of the operator, but fear the worst. It is almost superfluous to add, that if, as is probable, an excess of ammonia was added in precipitating the gold, the entire process was exactly that given in most chemical works for producing fulminating gold in its most explosive condition.—*Communicated by Prof. Morton.*

New Magnesia Burner.—During a visit which we lately made to the works of the New York Oxygen Gas Co., 547, West 41st Street, we saw a new burner in operation which had just been received from France, and which successfully meets the difficulty previously found in burning the oxygen light, with a very low pressure on the "burning-gas." Each elementary burner consists of three very minute jets, two at either side coming somewhat towards each other, which are supplied with the ordinary gas, and the other between them, and a little shorter, which is fed with oxygen. By this means, no matter how low the pressure on the illuminating-gas may be, no retreat of the flame into the jet can occur. We saw this burner, in fact, operating most excellently with a pressure of about 2-10th inch of water. We hear from Mr. C. H. Stoddard, that a yet further improvement is announced, of which specimens will soon be on hand.—*Communicated by Prof. Morton.*

Use of Calcium Lights at the Saint Louis Bridge.—From Mr. W. Milnor Roberts, who is in charge of the work, we hear as follows:—"We have used calcium lights only for our open-air work in laying masonry on the top of our caissons—one light on one side, and one at the other, on diagonal corners; we found that they distributed the best light when thus placed. We had the oxygen gas forced into copper gas-holders with a pressure of about 200 lbs. to the square inch. These were carried over from the city to the piers on a little steamer, and the gas was conveyed to the burner through small lead pipe. At first our reflectors were of glass, but so many were broken that they were replaced by metal. A man remained with the two burners through the night, to regulate them occasionally, and to mend the pipes when a burst occurred. They usually burn from eleven to twelve hours; and, with the aid of some movable large reflector lamps, the masons worked as well at night as in the day. The cost of the calcium lights to our company was 3·75 dollars per hour each."—*Communicated by Professor Morton.*

Death of Dr. Magnus, of Berlin.—We learn with great regret that the celebrated physicist, Dr. Heinrich Gustav Magnus, of Berlin, died there on the 4th inst.; the deceased was born at Berlin on the 2nd of May, 1802, and took the degree of Ph.D. at Berlin University in 1827, his inaugural dissertation written in Latin bearing title "De Tellurio." In 1834 he was appointed Extraordinary Professor of Natural Philosophy at Berlin University, and in 1845 became Ordinary Professor for the same subject. The deceased largely contributed to extend our knowledge of physical sciences, but owing to the great mass of his various contributions, it is quite impossible to give here even a brief outline of his labours. The deceased was a member of several scientific societies and institutions, and carried on a regular correspondence with the foremost scientific men in the civilised world.

Description of Browning's Automatic Spectroscope.—This instrument is furnished with a battery of six equilateral prisms of dense flint glass; all the prisms are joined together like a chain by their respective corners, the bases being in this manner linked together. This chain of prisms is then bent round so as to form a circle with the apices outwards; the centre of the base of each prism is attached to a radial rod. All these rods pass through a common centre. The prism nearest the collimator, *i.e.*, the first prism of the train, is a fixture. The movement of the

other prisms is then in the proportion of 1, 2, 3, 4, and 5, the last or 6th prism moving five times the amount of the second. All these motions are communicated by the simple revolution of the micrometer screw, which is used for measuring the position of the lines in the spectrum, and the amount of motion of each, and of the telescope, is so arranged that the prisms are automatically adjusted to the minimum angle of deviation for the ray under examination. It is easy to test the efficiency of the instrument in this respect. On taking the lens out of the eye piece of the telescope, the whole field of view is found to be filled with the light of the colour of that portion of the spectrum which the observer wishes to examine; while in a spectroscope of the usual construction, at the extreme ends of the spectrum, just where the light is most required, only a lens-shaped line of light would be found in the field of view. As a consequence of this peculiarity, the violet and deep red ends of the spectrum are greatly elongated, or rather much more of them can be seen than in an ordinary spectroscope, and the H lines, which are generally seen only with difficulty, come out in a marked manner.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

Under this heading will be found an encyclopædic list of chemical papers published abroad during the month, with abstracts of all susceptible of advantageous abridgment. The two half yearly volumes of the Chemical News, *with their copious indices, will, therefore, be equivalent to an English edition of the "Jahresberichte."*

Note.—*All degrees of temperature are Centigrade, unless otherwise expressed.*

Meteorite Observed at Alicante, Spain.—C. Miallej de.—The author states that, just about sunset on the 2nd inst., he observed, while walking on the pier (the town is situated on the Mediterranean), a meteorite, much akin in size, colour, and shape to, but far larger than, the planet Jupiter, moving with great speed from east to west.

Artificial Butter.—Dr. Mège.—When the stearic acid employed for making the so-called stearine candles, is strongly pressed (as is always done in its manufacture, to get rid of the oleric acid), an oily substance is obtained which, according to this author, is identical in composition with butter, but fluid. The author submits this material to several processes of infusion, decolouration, and beating (a kind of churning), and at last converts it, also, in physical appearance, into butter. The editor of this paper very properly adds that the Cossacks understand this matter far better, and with less ample machinery, since they, it is well known, are in the habit of converting oils readily into an unctuous substance by a simple process. The rationale, in both cases, is a partial saponification.

Journal für Praktische Chemie, No. 21, 1869.

This periodical contains the following original papers and memoirs:—

On Benzoic Acid and Gum Benzoin.—Julius Löwe.—The contents of this paper are the answers given to four queries, viz.:—(1) Does benzoic acid pre-exist in gum-benzoin ready-formed and in free state? (2) Is the benzoic acid present in the resin combined with a base? (3) Is benzoic acid a product of the oxidation of a part of the resin formed by the taking up of oxygen during the melting of the resin? (4) Is benzoic acid a product of a portion of the resin formed by the heat of the fusion of that substance? The author's experiments, detailed at great length, commenced with the finding of a reply to No. 3, and the result is a negative—viz., that when the process of sublimation (as usually employed for obtaining benzoic acid from gum benzoin) is carried on in atmospheres of hydrogen or carbonic acid gas, the quantity and quality of the acid obtained are the same as when the process is carried on in contact with air. As regards the replies to Nos. 1, 2, and 4, a series of experiments made in various ways proved, undoubtedly, the pre-existence of ready-formed benzoic acid in the resin. The last portion of this paper is devoted to the very minutely-detailed description of the best practical method of the preparation of benzoic acid from the resin.

Composition of Soda and Lime Felspar.—G. Tschermak.—Since some doubt has arisen concerning the proper place to be assigned, in chemical mineralogy, to the minerals just named, the author made analyses of carefully-selected minerals, with the following results for 100 parts:—Silica, 48·94 and 49·40; alumina, 33·26 and 32·60; lime, 15·10 and 15·05; soda, 3·30 and 2·95. The second numbers refer to and prove these felspars to be mixtures of 75 per cent of anorthite and 25 per cent of albite. The sp. gr. of the samples was, respectively, 26·72 and 2·723.

On the Haloid Compounds and their Derivatives Corresponding to Picric Acid and Dinitro-Phenol.—Conrad Clemm.—(Preliminary notice.) After briefly referring to Pisani's labours on this subject, the author says that the chloro-trinitro-benzol, obtained by causing pentachloride of phosphorus to act upon picric acid, is converted, by the action of ammonia and aniline, into trinitraniline and trinitro-diphenylamine, which latter substance yields, with sulpho-cyanide of potassium, a body, $C_{14}H_{11}N_6SO_{12}$. Chloro-dinitro-benzol has been prepared by the author from dinitro-phenol, as well as from chlorbenzol; both products are identical, and fuse about between 48° and 50°. By means of these compounds, it is possible readily to prepare from benzol, phenol derivatives. Dinitraniline has been prepared by the author by means of bi-nitrated bromobenzol, as, also, by means of chloro-dinitro-benzol; both products are identical, and their melting-point is 175°. Aniline and bromo-dinitro-benzol yield dinitro-diphenylamine, fusing at 153°. These researches will be continued, and the action of pure solid fused phenol upon sulphocyanide of potassium and upon sulphate of diazo-benzol will be invostigated fully.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 205, January, 1870.

This number does not contain any original papers relating to chemistry, but we meet here with a very extensive report, accompanied by several engravings, on—

Electric Clockwork and Machinery for Striking Hours and Quarters by means of Electric Action, as Executed by M. Fournier and Reported on by O. Tresca.

Moniteur Scientifique, No. 318, March 15, 1870.

This number contains the following original papers relating to chemistry and allied sciences:—

Quantitative Estimation of Sugar.—Georges Ville.—This paper, too lengthy for any useful abstraction, is divided into the following sections:—Apparatus required, illustrated by wood cuts; reagents; estimation of total quantity of sugar; estimation of glucose; calculation of results; estimation of sugar in vegetable tissues; estimation of sugar in vegetable juices; tabulated form to assist in the calculations.

Determination of the Commercial Value of Bleaching-Powder and Manganese.—G. Tissandier.

Some Experiments with Salts of Chromium.—A. Commaille.—This lengthy paper contains the following sections:—Nitric acid and bichromate of potassa; sulphuric acid and bichromate of potassa; chlorhydric acid and bichromate of potassa; iodic acid and bichromate of potassa; oxalic acid and bichromate of potassa; acetic acid and bi-

chromate of potassa; tartaric acid and bichromate of potassa; citric acid and the same salt; tannic acid and the bichromate alluded to; and, lastly, benzoic acid and the same salt.

Chemical Dance: Instantaneous Apparition of Aniline Colours.—Under this title, a somewhat verbose, but, after all, elegantly-described curiosity, is related as follows:—Some few weeks ago, Madame A. W. Hofmann gave a grand entertainment and ball to the large number of her eminent husband's pupils. In the ball-room were placed, on the table, a large number of bouquets of flowers (artificial, of course), all snow-white, and close by, on the same table, a large number of pieces of beautifully-white silk ribbon; at the other end of the room a fountain was arranged, throwing, from narrow openings, jets of exquisitely-perfumed eau de Cologne. The bouquets were taken by the ladies, and the ribbons by the gentlemen; and while waltzing together, and thus arriving at the end of the room where the fountain played, the ladies, holding their bouquets to be sprinkled over with the perfume, beheld the white flowers become suddenly beautifully red, violet, blue, yellow, and green-coloured, while the ribbons carried by the gentlemen assumed, under the same influence, similar colours. The secret of this trick is simply that the objects alluded to had been very gently dusted over with the dry powders of variously-prepared aniline colours, and, on becoming moistened by the eau de Cologne (alcohol), these powders became dissolved, and imparted colours to the objects.

Bulletin Mensuel de la Société Chimique de Paris, February, 1870.

From the *procès verbaux* of the meetings of this Society held in the month of January last, we learn, in the first place, that Ch. Friedel is the president of the Society for the present year, and MM. J. Bouis and E. Willm, secretaries. M. Terreil made a communication on the progress of his researches on the—

Treatment of Minerals by Saline Solutions.—(More especially alluding to the action of alkaline sulphides on native metallic sulphides.) Sulphide of antimony is readily dissolved; realgar (arsenical sulphide) is only incompletely dissolved; while the sulphides of tin and molybdenum (native) are not at all acted upon. Native sulphide of nickel and the white-coloured iron pyrites (mundic), also the magnetic pyrites, are slowly dissolved; but the yellow-coloured variety (coal brasses) is not acted upon. All minerals which contain sulphides of arsenic and antimony, as, for instance, ruby silver ore (grey antimony ore), are decomposed by alkaline sulphides; but mispickel, for instance, which is a metallic arsenide combined with sulphur, is not attacked by these solvents. Mispickel is an arsenical pyrites, containing iron, arsenic, and sulphur.

The President of the Society stated that he had been engaged with Dr. Ladenburg in researches on the—

Products of the Oxidation of Acetone.—Among these, mesoxalic acid has been found.

Dr. Wurtz spoke on the—

Synthesis of Organic Acids which can be obtained by Starting from Chlorinated Hydrocarbons by the Action of Chloroxycarbonic Ether in the Presence of Sodium.—Bromide of benzyle, treated with chloroxycarbonic ether and sodium amalgam, yields, with proper precautions, a complex crystallisable acid, $C_{15}H_{14}O_2$, dibenzyl-carboxylic acid, resulting from the action of one molecule of chloroxycarbonic ether upon two molecules of chloride of benzyl. The lime-salt of this acid yields, when submitted to destructive distillation, two hydrocarbons—viz., dibenzyle, $C_{14}H_{14}$; and stilben, $C_{14}H_{12}$.

The following papers were read:—

Chemical Equilibrium Existing between Carbon, Hydrogen, and Oxygen.—M. Berthelot.—This lengthy paper, which contains, also, the history of the earliest researches on the action of electricity upon gaseous compounds, is divided into the following sections:—Decomposition of carbonic acid; decomposition of aqueous vapour and steam; equilibrium between hydrogen, oxygen, and carbon; action of electric sparks upon mixtures of gases.

Spectra Exhibited by some Compound Bodies Present in Mixtures in the State of Equilibrium.—Dr. Berthelot and J. Richard.

Bromo-Toluen and Pseudo-Toluidine.—A. Rosenstiehl.—This paper is a very lengthy and sharply-critical reply to M. Wallach, who published an article under the above heading in the January number of this periodical.

Revue Hebdomadaire de Chimie, March 10, 1870.

Apparatus for the Evaporation of Beet-Root Juice, designated as *à Triple Effet*.—M. Schreiber.—A description of a very useful contrivance for the utilisation of waste steam for the purpose of evaporating the juice while circulating, so as to obviate, as much as possible, the formation of calcareous deposits from the juice against the sides of the evaporating pan.

Volumetrical Assay of the Iodine of Commerce.—A. Bobierre.—An aqueous solution of iodide of potassium of known strength is made and kept invariable for a number of assays; this solution being destined to dissolve the iodine to be tested. Next, a solution (normal) of arsenite of soda is made, by dissolving, in a litre of water, 4·95 grms. of arsenious acid and 14·5 grms. of crystallised carbonate of soda (pure); this liquid completely decomposes any iodine containing liquid, the quantity of that haloid amounting to 12·688 grms. to the litre. A solution of bicarbonate of soda in cold water is made, rather concentrated, to be used as will be indicated presently. Take a small glass-stoppered bottle; pour into it 10 c.c. of the arsenite of soda solution and 5 c.c. of the bicarbonate of soda solution, and next 4 c.c. of benzol. Weigh off any quantity of a sample of pure iodine; dissolve it in a quantity of the above-mentioned solution of iodide of potassium, fill with this solution, which is, of course, brown-coloured, a bottle of 100 c.c. capacity. Shake the bottle containing the liquid, and pour, *guttatim*, into a graduated burette; the brown colour will disappear, the benzol becomes rose-coloured, and the aqueous liquid yellowish. It is clear that a second assay, made with the same quantity, by weight, as the first, but of the iodine to be tested, will give as result the richness of the sample in iodine, because the bulk of the solution required for the decomposition of the alkaline arsenite is inversely proportioned to the real quantity of iodine sought for.

Process of Sugar Manufacture.—M. Mueseler.—This process is based upon capillary action, but the description here given is too vague to give any adequate idea of its practical applicability.

Testing of Alcohol and Spirits for Amylic Alcohol.—Since the internal use of amylic alcohol, even in small quantity, is very deleterious, the means of rapidly testing for its presence in spirits and alcohol (either for pharmaceutical or scientific use) is of importance. The suspected alcohol is poured into a burette, mixed with its own bulk of rectified and pure ether, and also its own bulk of water, and the mixture gently shaken; the ether, on becoming separated from the rest of the fluid, floats to the top, containing in solution the whole of the amylic alcohol which might have been contained in the alcohol or spirits under examination. The ether is removed by a pipette, and on leaving it to spontaneous evaporation, will leave behind the amylic alcohol, readily detected by its offensive smell.

Description of a Newly-Invented Apparatus for Preparing Animal Charcoal.—MM. Guilbert, at Eth (Dep. du Nord).—Accompanied by woodcuts.

Preparation of Neutral Perchloride of Iron.—M. Bouilhon.—This process may be summarised as follows:—Dissolving of iron in dilute hydrochloric acid, aided by

heat; evaporation of the solution obtained, and crystallisation; solution of the crystals in distilled and previously well-boiled water, cooled without contact of air; passing a slow current of chlorine through this solution while in rather concentrated state.

Preparation of Caffeic Acid.—J. Hlasiwetz.—Take of extract of coffee (raw or green), 50 grms.; dissolve in 120 c.c. of tepid water; add 50 grms. of caustic potassa. Boil this mixture for an hour in a large retort provided with a condenser; saturate the potassa with sulphuric acid; shake the mixture three times with fresh quantities of ether; remove that liquid by distillation, when crude caffeic acid is left, which is dissolved in water and purified, by means of animal charcoal. From the above-quoted quantity, 6 grms. of the pure acid are obtained.

Estimation of Bromide of Potassium Mixed with Chloride.—Dr. Baudrimont.—Test the sample qualitatively, first, for carbonate and the presence of iodide, since especially the latter renders the bromide unfit for medicinal use, and its presence would also interfere with the process of analysis to be described. (It should be remembered that 1 grm. of bromide of potassium requires for precipitation exactly 1·428 grms. of nitrate of silver, and that 1 grm. of chloride requires exactly 2·278 grms. of the same nitrate for the same effect.) Dissolve 1 grm. of the suspected bromide in 100 c.c. of distilled water; take 10 c.c. of this solution, which precipitate completely, by a solution of nitrate of silver *au centième* (1 part in 100 of water), poured out of a burette graduated so as to be enabled to read off tenths of c.c. If the bromide is pure, 142 of the divisions of the burette filled with the nitrate of silver solution will be required; if the salt contains chloride, more of that solution will be required; and, since the perfectly pure chloride would require 227 divisions, it is readily found by calculation what amount of chloride the bromide contains.

Adulteration of Sub-Nitrate of Bismuth.—This salt has been of late frequently sophisticated with phosphate of lime (bone-ash). To detect this, the salt in question may be dissolved in nitric acid, and this solution precipitated by carbonate of potassa solution. If the bismuth-salt is pure, it is re-dissolved in excess of that precipitant; but any phosphate of lime present is not rendered soluble by this reagent. Of course other sophistications may exist, and therefore proper tests have to be applied to ascertain the nature of the substance.

Les Mondes, March 17, 1870.

Imperial Society of Sciences at Lille (Nord, France).—Prize of 1000 francs (£40) for the best work on any of the subjects of experimental natural philosophy on which hitherto no monograph has been published (by this Society?); June 1st, 1870. Same-valued prize for a work on clinical thermometry; October 1st, 1872. Gold, silver-gilt, silver, or bronze medals for—An elementary work for schools, on the mechanical theory of heat, and its applications to machinery; researches concerning the different qualities of butcher's meat, with proper elucidation of the cause why inferior qualities of meat are less nutritive, for the same weight, than better ones; description of the simplest means of obtaining proper ventilation in cafés, estaminets, and other rooms, by the aid of the ordinary methods of lighting and heating; renewed study of the chemistry of sugar manufacture (beet-root); renewed study of colouring matters; renewed study on bleaching materials. We have left out all questions belonging to physiology and natural history, as well as those of local importance only.

Pneumodensimeter.—A. de Negro.—Description, illustrated with several engravings, of very great and important improvements effected in Bunsen's apparatus for the estimation of the specific gravity of gases, by determining the duration of their flow through very narrow openings, or through very thin plates. The apparatus, as described, is self-registering.

American Journal of Pharmacy, March, 1870.

Contains the following original papers relating to chemistry and allied sciences:—

Notice of M. Carre's Apparatus for Ice-Making.—W. Procter.—It appears from this paper that this invention, wherein ammonia gas liquefied by pressure is applied, is a decided success.

Reaction between Spirit of Nitrous Ether and Bicarbonate of Potassa.—Dr. Rademaker.—The author states that, while keeping sweet spirits of nitre, prepared according to the U. S. P., in a bottle containing, as advised, bicarbonate of potassa in crystals, he observed these crystals change form. On examining the same, and applying tests, he found that nitrite of potassa had been formed, while the liquid, which had been prepared with great care, was neutral to begin with and had remained so; no perceptible solution had taken place. Aqueous solution of bicarbonate of potassa readily decomposes the fluid in question.

Assay of a Pure American Opium.—W. Procter, jun.—In 100 parts, this sample, obtained from plants grown from foreign seed, contained—Morphia, 15·75; impure narcotine, 2·0; meconic acid, 5·25; caoutchouc, fatty matter, and resin, 11·00; residue insoluble in benzol (including 0·5 ash), 22·0; matter soluble in water, other than salts of morphia and narcotine (as gum, extractive, &c.), 38·5; water, 5·0. No attempt was made to isolate codeia, narceia, meconine, and the like.

On Sulpho-Carbolic Acid and Sulpho-Carbolates.—W. Procter, jun.—Too lengthy for useful abstraction. An excellent paper for perusal for good methods of preparation of these substances.

Zinc Sulpho-Phenate.—Dr. Hagar.—A lengthy paper on the preparation of this salt for pharmaceutical use.

Solution of Citrate of Magnesia.—B. Rother.—This paper contains an excellent review of the various salts citric acid and magnesia yield, and a good formula for the preparation of a pharmaceutically-useful solution of a citrate of magnesia, soda, and potassa.

This number contains, in addition to the papers alluded to, several good papers of purely pharmaceutical importance.

Comptes Rendus des Séances de l'Académie des Sciences, March 21, 1870.

The number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Analysis of, and Useful Applications of, Gaize.—H. Sainte-Claire Deville and J. Desnoyers.—There occurs, in the Departement des Ardennes, France, a variety of hydrated silica known by the name of gaize, and geologically situated below the cretaceous deposit; the thickness of this layer is 30 metres, and it extends over a distance of 40 kilometres (24·85 English miles). The sp. gr. of this substance is 1·48 in crude state, and after ignition 1·44; in 100 parts, it consists of—Hygrometrical water, 3·4; combined water, 3·2; soluble silica, 43·7; insoluble silica, 40·8; alumina, 3·8; peroxide of iron, 2·9; lime, 0·9 (we only quote one of the very large number of analyses mentioned in this memoir). This stone is used as a building stone; it is, at first, quite soft, so that it can be cut with a knife. Since the authors found that this material resists a very high temperature without fusion or cracking, or, also, of perceptible contraction, either cubical or linear, they recommend it for the manufacture of crucibles (on the lathe), for fire-bricks, and for furnaces. Some specimens of bricks and crucibles made from this material were exhibited at the meeting.

Variations of the Calorific Capacity of Water when Approaching its Maximum of Density (Specific Gravity).—M. Hirn. A memoir of considerable length, and too full of figures to admit of useful abstraction.

Action of Sulphide of Carbon and Carburetted Gases (*des gaz carbures*) on Wood Charcoal.—J. Sidot.—The author describes, at some length, a series of experiments made by him. When the vapours of sulphide of carbon, of wood-spirit, and some of the liquid hydrocarbons are passed over wood charcoal at an elevated temperature, that substance undergoes, at least superficially, a very curious change, and is converted into a sonorous, metallic-looking material, becoming, at the same time, a good conductor of heat and electricity, and no longer capable of absorbing gases; it is, in fact, converted into a peculiar kind of graphite, but only superficially.

On Cobalt and Manganese, and their Alloys with Copper.—A. Valenciennes.—The author exhibits specimens of cobalt and manganese fused in crucibles made of magnesia. The former metal is very similar to iron, but far harder, yet readily wrought in the lathe. Manganese is a very hard, but brittle metal, very readily oxidised in the air; the specimen was pure, having been made from pure peroxide. Notwithstanding the similarity cobalt possesses to iron, the former readily alloys with copper, which iron does not. The alloys of manganese and copper are very similar to those of copper and tin, but very hard and brittle when the proportion of manganese is above 8 per cent of the mixture.

Vertical Beam Galvanometer.—M. Bourbouze.

Electro-Chemical Essay on Ozone.—E. Martin.—This paper was not read—its title only is mentioned.

Nature of the Motive Power which Produces the Phenomena of Endosmosis.—A. Rosenstiehl.—This lengthy memoir, full of quotations from other periodicals, is not well suited for any useful abstraction.

New Method of Preparation of Bromhydric Acid.—MM. Champion and Pellet.—This process is based upon the reciprocal action of the vapours of bromine upon those of paraffin, the latter substance being heated to 185°, and the former to 65°, each in a separate retort. The somewhat complex reaction results, ultimately, in the formation of bromhydric acid, of which, by this means, a concentrated aqueous solution is obtained, which, if saturated at 0° (32° F.), has a sp. gr. of 1·78, and contains in every c.c, 1·46 grms. of bromhydric acid, while the formula of this compound is $BrH,_2HO$. On being heated, gas is evolved; but, simultaneously, a hydrate is obtained boiling at 126°; its formula is $BrH,_{10}HO$; its sp. gr. is 1·48.

Properties of Iodic Acid.—A. Ditte.—This very lengthy and exhaustive memoir treats (1) on anhydrous iodic acid, and (2) hydrated iodic acid. The paper is a monograph on the subject, but not suited for any useful abstraction.

Hydrogenated Derivatives of Sulphide of Carbon.—Aime Girard.—After referring to older experiments made on this subject, the author states that he has succeeded in substituting hydrogen for half of the sulphur contained in sulphide of carbon, thus constituting a compound containing equal equivalents of carbon, hydrogen, and sulphur. By analysing the compounds this new substance forms with nitrate of silver, chloride of mercury, and chloride of platinum, the author has been enabled to fix the formula of this substance as $C_4H_4S_4$, and that it is bisulpho-methylen. The formula of the platinum compound is—

$$C_{12}H_{12}S_{12}.2PtCl+2(C_{12}H_{12}S_{12})4PtCl_2=$$
$$=3(C_4H_4S_4)2PtCl+6(C_4H_4S_4)4PtCl_2.$$

In 100 parts—Carbon, 12·2; hydrogen, 2·0; sulphur, 32·5; platinum, 33·3; chlorine, 20·0.

Vitality of Beer-Yeast.—J. Melsens.—This lengthy chemico-physiological memoir is divided into the following sections:—Fermentation at 0°(32°F.); freezing of beer-yeast under pressure; freezing of beer-yeast, or of malt, in solution, by means of the paste of ether and solid carbonic acid *in vacuo*; resistance of beer-yeast in wort at a higher temperature; destruction of the vitality of beer-yeast, when the fermentation, produced by it, and going on in a closed vessel, causes the pressure to rise to 25 atmospheres (375 English lbs.) pressure to the square inch. The chief results of the author's researches are: That fermentation is possible in the midst of melting ice, at which temperature seeds do not germinate. Beer-yeast resists (that is, is not deprived of its capability of inducing fermentation) freezing when surrounded by water, and resists the effort of dilatation (expansion) which is so strong as to break vessels capable of resisting 8,000 atmospheres' pressure (120,000 lbs.) to the square inch. The energy of the ferment is diminished, but its vitality is not destroyed, by the lowest possible temperature which can be artificially made—viz., about 100° C. below zero. Alcoholic fermentation is suspended when the temperature is maintained for some time at 45° (113° F). Alcoholic fermentation is arrested, when that operation is going on in closed vessels, as soon as the carbonic acid evolved causes a pressure of 25 atmospheres, and in that case the yeast is killed (*tuée*). The following observations on the contents of this paper were made by M. Boussingault, who says—"It is not at all remarkable that beer-yeast should resist the action of very low temperatures, since the same has been observed with various kinds of seeds purposely exposed to a cold of—100°, which seeds germinated afterwards." But the speaker takes exception to the fact announced that fermentation should go on at a very low temperature, and states that when he repeated, during the very great cold of the winter of 1848, Vergnette's experiments, he found that ferments were killed and fermentations arrested by that low temperature.

Chemical Conditions of the Life of the Lower Organised Animals.—J. Raulin.—A physiologico-chemical paper.

On Tribromhydrine.—L. Henry.—The author describes, at great length, the preparation of this body, which, in pure state, is a neutral, colourless, ethereal liquid, of 2·407 sp. gr. at 10°, insoluble in water, and boiling at 219°; by the aid of a low temperature, it can be obtained in crystalline state. Its equivalent is 281; its percentage composition—Carbon, 12·81; hydrogen, 1·78; bromine, 85·40. Formula, $C_3H_5Br_3$. The author enters into some details on the action of caustic potassa upon this substance, but has not quite finished his researches in this direction.

Isomeric Xylens and Cumens met with in Coal-Tar Oils.—M. Rommier.—A continuation of a former paper on this subject.

Fall of a Meteorite at Mourzouk (Barbary).—M. Coumbary.—The author, writing from Tripoli, states that, on the 25th of December last, there was observed, at Mourzouk (Fezzan), lat. 26° N., long. 12° E. of Paris (14° 20′ 26″ E. of Greenwich), a most extraordinary fall of a meteorite, accompanied by a heavy report of an explosion, and so strong a scintillation of sparks that a group of Arabs, who were near the spot, became so frightened that they fired their guns at the heavenly monster. The Turkish Government has very laudably taken proper measures to secure the meteorite; but, since the distance from Tripoli to Mourzouk is very great, and the roads hardly fit for traffic, it is a month's journey to reach the latter place. At the end of this letter, it is incidentally mentioned that, in the farther interior of this region (Africa), the Sultan of Wadai, and all the grand personages of his Court, are armed with swords, lance-heads, and sabres made from iron fallen from heaven, which is very abundant there.

Revue des Cours Scientifiques de la France et de l'Etranger, March 26, 1870.

This number does not contain any papers relating to

[English Edition, Vol. XXI., No. 540, pages 153, 154.]

chemistry, but we quote the titles of the following memoirs of general scientific interest met with in these pages:—

Existence of Man at the Tertiary Period.—A. Favre.

Spectroscopic Observations of the Solar Protuberances.—G. Rayet.

Action of the Sympathetic Nervous System.—Dr. P. Bert.—A public lecture given to a mixed auditory at the Sorbonne, illustrated with diagrams.

Revue Hebdomadaire de Chimie, March 17, 1870.

Manufacture of Carbonate of Soda.—MM. Schlœsing and Rolland.—This process is based upon the reaction which takes place when carbonate of ammonia reacts upon common salt, both salts being in aqueous solution. There is thus obtained bicarbonate of soda of great purity, which crystallises; and in the solution there remain chloride of ammonium and an excess of the bicarbonate of that base.

Peruvian Guano.—Ch. Mène.—It appears that the Peruvian Government has come to the decision that no guano from the Chincha, Macabi, and other islands, may be exported, except to the United States and the United Kingdom, with the view of settling, by this means, the debts owed by Peru to these countries. The author enters into some details about the fixation of the ammonia in this substance.

Regenerating Stale and Ropy Beer.—M. Mène.—According to this process, the liquids alluded to are boiled up, first, with spent hops, and afterwards fermented again; but it is very difficult to see that this treatment can do any good. It is best to use such fluids as stale and ropy beer either for vinegar making or throw it away into the manure of the horses employed at the brewery, since that is its best place.

Zeitschrift für Chemie von Beilstein, No. 4, 1870.

This number contains the following original papers and memoirs:—

Further Researches on the Constitution of Piperic Acid.—J. Remsen and R. Fittig.—The authors have studied the action of hydrogen, in nascent state, upon piperonal and piperonylic acid. The first of these substances yields, when treated with sodium amalgam and water, three different and well-characterised substances, viz.:—Piperonyl alcohol, $C_8H_8O_3$, a solid body, fusing at 51°, crystalline, difficultly soluble in water, readily soluble in alcohol, not volatile without undergoing decomposition, and yielding, with chloride of acetyl a fluid acetic ether, while hydrochloric acid is given off. Hydropiperoine, $C_{16}H_{14}O_6$, a solid body, insoluble in water, and also in cold alcohol; difficultly soluble in boiling alcohol, from which solution it crystallises on cooling, exhibiting lance-shaped crystals fusing at 202°. Isohydropiperoine, $C_{16}H_{14}O_6$, a solid substance, insoluble in cold water, but readily in boiling, very soluble in alcohol, crystalline, and fusing at 138°. The authors describe, at great length, the action of the two last-named substances, in contact with chloride of acetyl and with nitric acid; the result, as regards the latter, being mono-nitropiperonal, $C_8H_5(NO_2)O_3$, a solid crystalline body, insoluble in water when cold, but better soluble in hot water and boiling alcohol, and fusing at 95°. This very lengthy memoir contains, further, the account of the action of chloride of phosphorus upon piperonal, represented by—

$$C_7H_5O_2-CHO+PCl_5=C_7H_5O_2-CHCl_2+PCl_3O,$$

producing piperonal chloride, a fluid boiling at between 230° and 240°. By the action of water and dilute hydrochloric acid, piperonylic acid yields protocatechusic acid and pyrocatechin.

Isomeric Nitrotoluols and Toluidines.—F. Beilstein and A. Kuhlberg.—This paper contains the description of the following compounds:—Nitrited acetoluide, $C_7H_6(NO_2)$, NHC_2H_3O, a solid substance, fusing at 92°, and insoluble in water; isomeric nitrotoluidine, $C_7H_6(NO_2)$, NH_2, a solid crystalline body, readily soluble in alcohol, and fusing at 114°; ortho-nitrotoluol, $C_7H_7NO_2$; ortho-toluidine; ortho-acetcluide, C_7H_7,NHC_2H_3O; dinitrotoluol, $C_7H_6(NO_2)_2$; metaiodtoluol, C_7H_7I; solid iodnitrotoluol, $C_7H_6(NO_2)I$; chlorotoluidine, $C_7H_6ClH_2N$.

Contributions from the Technical Laboratory of the University of Kasan, (Russia).—A. Saytzeff.—This paper is divided into the following sections:—On amyl-ethyl-sulphide; action of zinc-sodium alloy upon a mixture of anhydrous acetic acid and iodide of alcohol (*alcohol jodür*); action of pentabromide of phosphorus upon bromacetyle; a new method for the conversion of fatty acids into the corresponding alcohols; synthesis of normal butylic alcohol; synthesis of alcohol (*Weingeist*); synthesis of normal propylic alcohol; on the proportion of oxygen combining with some of the organic derivatives of bivalent (*zweiwerthig*) sulphur; and on the behaviour of iodide of ethyl towards ethyl-bisulphide.

Action of Ammoniacal Salts upon Oxide of Copper.—J. Tüttschew.—When finely-powdered black oxide of copper, obtained by the ignition of nitrate of copper, is boiled with a solution of chloride of ammonium for a length of time, the oxide loses its colour and becomes greenish; when, after continued boiling, the mixture is evaporated to dryness, and next exhausted with water, a green powder and a bright blue-coloured solution is obtained. This powder, after having been well washed and dried, first at the ordinary temperature of the air, and lastly in the air-bath at between 120° and 140°, yields, on analysis, for 100 parts—Water, 17·02; chlorine, 16·10; oxide of copper, 70·05. The substance is, therefore, almost exactly similar to the mineral known as atakamite, from Copiapo, Chili, which, according to Dr. Rammelsberg's analysis is—

$$2(CuCl+3CuO)+9HO;$$

in 100 parts—Chlorine, 15·65; water, 17·88; oxide of copper, 70·00. When the oxide of copper is similarly treated with a solution of sulphate of ammonia, a salt is obtained consisting, in 100 parts, of—Oxide of copper, 67·87; sulphuric acid, 18·73; water, 13·40. Or a substance very similar to the mineral brochantite, from Krisuwaga, Iceland, consisting, in 100 parts, of—Oxide of copper, 67·75; sulphuric acid, 18·88; water, 12·18. With a solution of carbonate of ammonia, which, by-the-by, is itself decomposed by boiling, a substance was obtained containing, in 100 parts—Carbonic acid, 19·02; oxide of copper, 70·24; water, 10·74. With nitrate of ammonia, a substance is obtained containing, in 100 parts—Oxide of copper, 65·54; water, 18·94; nitric acid (N_2O_5), 15·52; or very nearly the substance, $2(6CuONO_5)+15HO$.

No. 5, 1870.

This number contains the following original papers:—

On M. Wyrouboff's Critical Remarks concerning the Labours of M. Reindel.—This paper contains the following sections:—Decomposition of ferrocyanide, by means of nitrate of soda, by crystallo-chemical reaction; action of chloride of copper on ferrocyanide of potassium. It is not possible to make any useful abstract of this paper.

Adulteration of Rice Meal.—A. D. van Bastelaer.—According to the author, properly-prepared macerated solutions of flour and meal of wheat, rye, barley, oats, Indian corn, buckwheat, peas, and beans, and linseed yield precipitates with concentrated solutions of picric acid. A reaction, due, in all probability, to the action of picric acid upon the albuminous compounds of these substances, which are hardly at all present in rice; and hence the fact that the meal of that cereal yields no precipitate with the reagent alluded to. The method of testing is executed as follows:—20 grms. of the flour to be tested, previously well freed from bran and husk,

is mixed with 100 grms. of cold water, and left standing with that fluid, at a temperature of 11° or 12°, for an hour, care being taken to stir the mixture frequently. The mass is next brought on to a filter and to the filtrate a cold saturated solution of picric acid is added; if this causes, in the case of rice-meal, a precipitate, one may be sure that substance has been adultrated with other meals. The meal obtained from ergot of rye also yields, with picric acid, a precipitate, if treated as above described.

Property of Amorphous Silicic Acid of Absorbing Moisture from the Air.—A. Souchay.—The author states that Dr. Lippert, while assistant to Professor R. Fresenius, made the observation that amorphous silica, after having been strongly ignited in a platinum crucible, attracted moisture from the air to a large extent; in consequence whereof, and to test this fact precisely, the author instituted a series of experiments, from which the following results are drawn:—Amorphous silica is always hygroscopic after ignition; the degree of hygroscopicity differs greatly, according to the degree of heat the silica has been ignited—so that feebly-ignited silica is far more hygroscopic than when strongly ignited. When silica has been only feebly ignited, its avidity for the absorption of water, even after the lapse of a few minutes, is so great as to cause, if not taken into account, serious faults in the weighing and quantitative estimation of that substance. Crystalline silica, even when feebly ignited, is not at all hygroscopic.

Les Mondes, March 24, 1870.

Meteorological Observatory at Montsouris.—To this institution, established by M. C. Sainte-Claire Deville, a grant of £2,400 has been made by the French Minister of Public Instruction for the current year, with the arrangement that the peculiar work to be done has to comprise—(1) The complete study of all the facts relating to the climate of Paris, and the observation of the phenomena of physical interest pertaining thereto; (2) the calculation and digestion of the older observations on record; (3) the collection and redaction of the daily observations made in France and abroad, as far as they are published or transmitted daily by telegraph; (4) the daily publishing of all the results of observations made.

Technical Education and Instruction.—By decree of the 19th inst., His Majesty the Emperor of the French has, upon the proposition of the Minister for Agriculture and Commerce, approved of the establishment, under the said Minister, of a superior council of technical education, a permanent committee of thirty-two members to be chosen from among the Legislative Assembly, the higher public instruction (professors of universities), the Imperial Conservatory of Arts and Works, the Committee of Arts and Manufactures, the heads of great industrial establishments, the free public instruction, and the Administration (Préfets, Maires, &c.). A sum of £20,000 has been granted to the Minister aforesaid, for the purpose of encouraging technical education; and the committee just alluded to will have to aid and advise the Minister and other parties in the carrying out of a good and useful technical instruction.

A New Aspirator.—Dr. Bleckrode.—This paper is illustrated with a woodcut, absolutely required for the description of a very useful piece of apparatus, which can be readily made with the ordinary appliances at hand in any laboratory, and is so contrived as to admit of permanent action if desired.

Cosmos, March 26, 1870.

Relation between the Variations of the Barometer and those of the Thermometer.—H. H. Hildebrandsson.—A meteorological paper of some importance.

Origin of Petroleum.—V. Meunier.—Three theories exist on this subject, viz.—That the petroleum is the result of the distillation of coal situated within reach of sources of heat of volcanic origin; that it is the result of a peculiar decomposition of substances of animal and vegetable origin; and that petroleum owes its origin to volcanic emanations condensed by pressure and cooling of the superincumbent layers of rock and earths. According (says the author) to researches recently made, it is probable that, since there undoubtedly exists some relation between the deposits of sulphur, petroleum, and rock-salt, the origin of petroleum is due to volcanic agency.

Intended Journey of Russian Scientific Men to the Western Portion of Europe.—A committee of the following gentlemen are preparing for a journey through Germany, France, the United Kingdom, and other parts of Europe, for the purpose of studying the progress made by science in all its branches in Western Europe:—Profs. Chrrouszcrewsky, Kowalewsky, and Hibel, of Kiew University; the Grand Master of Dorpat University, Dr. M. Kepen; Profs. Prachoff and Baraniecky, of St. Petersburg University; Prof. Sobler, of Moscow University; Profs. Wladiniwoff and Kolosoff, of Charkoff University; Dr. Brandt, of St. Petersburg, and Dr. He, of Kasan University.

Zeitschrift für Analytische Chemie, Nos. 3 and 4, 1869.

The publisher of this periodical informs us that a strike of long duration among compositors and pressmen in a portion of Central Germany has caused a delay of several months in the issuing of this periodical, of which the two numbers now before us (a volume of some 300 pages) contain the following original memoirs and papers :—

Collocation of the Specific Gravities of Aqueous Solutions.—Dr. G. T. Gerlach.—This very useful tabulated form is arranged in the following manner:—At the top of the pages, divided into nine columns, we find, under the figures A, B, C, &c., to I, inclusive—The chemical formula and the equivalent of the substance in solution, in anhydrous as well as in hydrated or crystallo-hydrated state; quantities by weight of the hydrated substance contained in 100 parts of the solution; quantities by weight of the anhydrous substance in 100 parts of the solution; atoms of the anhydrous salt + 100 parts of water by weight; relative volume (bulk) of the solutions, taking the 100 parts by weight of water used for solution = 100 volumes; specific gravity of the solution; volumetrical degrees according to Gay-Lussac; name of the experimenter; temperature, and quotation of the book or periodical where the results here collected have been originally published. As regards the substances here named, they are—Caustic ammonia; caustic potassa and soda; the carbonates of the two last-named bases; chloride of ammonia; chloride of potassium; chloride of sodium; chloride of aluminum; chloride of magnesium; chloride of calcium; chloride of strontium; chloride of barium; chloride of cadmium; chloride of zinc; chloride of tin (SnCl); perchloride of tin; the bromides of potassium, sodium, lithium, magnesium, calcium, strontium, barium, cadmium, zinc; the iodides of potassium, sodium, lithium, magnesium, calcium, strontium, barium, cadmium, zinc; hyposulphites of soda; the sulphates of ammonia, potassa, soda; protoxide of manganese; protoxide of iron; protoxide of iron and ammonia; sulphates of magnesia and potassa ($KO.SO_3+MgOSO_3+6HO$; sulphate of zinc; of copper; neutral and bichromate of potassa; neutral phosphate or soda; basic phosphate of soda; neutral arseniate of soda, $2NaOHO+AsO_5+24HO$; basic arseniate of soda, $3NaO.AsO_5+24Ho$; the nitrates of potassa, soda, magnesia, strontia, baryta; oxide of lead; chlorate of potassa; bromates of potassa and soda; iodates of potassa and soda; ferrocyanide of potassium and ferricyanide of potassium; neutral acetate of lead; neutral tartrate of potassa (KO.T); neutral tartrate of soda; tartarus natronatus; tartrate of potassa and soda; hydrochloric acid (ClH); sulphuric acid; sulphurous acid; phosphoric acid; arsenic acid; nitric acid; acetic acid; tartaric acid; citric acid. The paper further contains the

following sections :—The legal (gesetzmässig) continuation of the specific gravities of equally-concentrated solutions; changes of bulk, which take place during the solution of salts; changes of bulk which take place when aqueous solutions of salts are diluted with water; changes of bulk which take place when different solutions of salts are mixed. There follows next a series of tabulated forms, containing—(1) The specific gravities of almost all hitherto-investigated aqueous solutions of salts, of caustic alkalies, of acids, and of sugar and alcohol. We cannot enter into more details, but should think that, since the portion of text to be translated is very small, these tables might be very usefully published in English in a separate volume, since the collection is highly useful, not only to scientific men, but also to very many manufacturers.

Contribution to the Means of Detecting, and Characteristic Reactions of, Citric Acid.—H. Kæmmerer.—Since the value of this paper rests entirely upon the woodcuts annexed thereto, representing microscopically-observed substances, we cannot enter into any further details.

Reciprocal Method of Calculating Atomic Formulæ, and especially those of Silicates.—Dr. Mohr.—This paper cannot be read without the re-production of a series of tabulated forms belonging to it.

Contribution to the Methods of Analysing Mineral-Water.—Dr. Mohr.—A short paper. Reserved for full translation.

On R. Wagner's Chlorometrical Method.—Dr. Mohr.—A reply to Dr. R. Wagner, who thinks that the author's criticisms on his (Wagner's) method, as published by the author in his celebrated work on volumetrical analysis, are based on erroneous views.

Analysis of Manganese.—Dr. Mohr.—A short but valuable paper. Reserved for full translation.

Presence of Peroxide of Hydrogen in Air.—H. Struve.—The chief results contained in this paper are—(1) Peroxide of hydrogen is formed in the air simultaneously with ozone and nitrate of ammonia, and is condensed in the meteoric waters; (2) peroxide of hydrogen, ozone, and nitrate of ammonia, are intimately connected together; (3) the change which the so-called ozone-paper undergoes when exposed to air is due to the joint action of ozone and peroxide of hydrogen; peroxide of hydrogen does not decompose solution of iodide of potassium with separation of free iodine; (5) free carbonic acid decomposes the solution of iodide of potassium, causing the formation of carbonate of potassia and free hydriodic acid; (6) when the peroxide of hydrogen is present along with carbonic acid (acting as just alluded to), iodine is separated; (7) the best and most effective reagent for the detection of small traces of peroxide of hydrogen is oxide of lead, since puce-coloured peroxide is formed. The author describes at great length the reactions and the proper application of the same.

Comptes Rendus des Séances de l'Académie des Sciences, March 28, 1870.

This number contains the following papers relating to chemistry and physical sciences :—

Application of an Electric Current in Calorimetry.—J. Jamin, this paper is divided into the following sections :—Application in the case of solids and liquids; gases and vapours; latent heat; the two specific heats.

Specific Heat of Water between 0° and 100°.—J. Jamin and A. Amaury.—An algebraico-physical paper, containing a very large number of tabulated results, in figures. There is annexed to this paper another, by V. Regnault, containing a series of observations and remarks on the contents of the essay of the authors.

On Trichlorhydrine and Substances Isomeric therewith.—J. Berthelot.—The chief leading points of this lengthy paper are that hitherto no trichlorhydrine has been prepared, except by the aid of substances derived from glycerine. There exist, moreover, at the very least, five bodies isomeric with trichlorhydrine, viz. :—(1) The chlorinated derivatives from the hydride of propylen C_6H_6, including, in all probability, those of the normal propyl-chlorhydric ether; (2) the derivatives from the chlorhydrate of propylen, $C_6H_6.HCl$, or the isopropyl-chlorhydric ether; (3) the derivatives from the normal chloride of propylen, $C_6H_6.Cl_2$, corresponding to the chloride of ethylen and diatomic alcohol; (4) the derivatives from dichlorhydric aceton; (5) the derivatives from trichlorhydrine, $C_6H_5.Cl_3$, corresponding to glycerine—that is to say, a normal triatomic alcohol.

Supersaturation of Chloride of Calcium.—E. Lefebvre.—This paper is an excellent contribution to the study of the phenomena presented by some saline solutions under various circumstances. The author first alludes to the well-known phenomenon presented by solutions of sulphate of soda, under certain conditions, which crystallise instantaneously. Solutions of chloride of calcium, and of the chlorides of strontium and barium, exhibit, if properly concentrated, the same sudden crystallisation; and the contents of this paper record the results of the author's extensive researches on this subject.

Chemical Research on Eucalyptol.—S. Cloëz.—The tree known by the name of *Eucalyptus globulus*, a native of Tasmania (where this specie was discovered, in 1792 by M. Labillardière) has been successfully acclimatised in the southern parts of France and other parts of Southern Europe. The author has discovered, in the leaves of that tree, a substance which he has named eucalyptol, a liquid specifically lighter than water, viz.—0·905 at 8°. Eucalyptol is difficulty soluble in water, but easily soluble in alcohol; this solution, when very dilute, has an odour analogous to that of roses. The formula of this substance is $C_{24}H_{20}O_2$; its vapour density, 6·22. Treated with anhydrous phosphoric acid, eucalyptol yields eucalypten, $C_{24}H_{18}$. The quantity of eucalyptol contained in the leaves of this tree, which, by-the-by, is, like the other eucalyptus species, remarkable on account of growing to heights of 80 and 100 metres, varies from 2·75 to 6 per cent.

Zeitschrift für Analytische Chemie, Nos. 3 and 4, 1869 (continued).

Contribution to the Knowledge of the so-called Nitrate of Iron of Commerce.—E. Lenssen.—Under the above name, there is met with in commerce an oily fluid of a blackish brown colour, and generally as heavy as 50° Baumé (1.525 sp. gr.); it tastes rather astringent, while it gives off a smell of nitrous acid; it is used very largely in dyeing and printing. The author has analysed several different samples of this material and gives the following three analysis as instances of what is sold (on the continent) for nitrate of iron. Sample marked N contained, in 100 parts—Peroxide of iron, 18·8; protoxide of iron, 0·4; sulphuric acid, 23·3; hydrochloric acid, 0·9; water, 56·6 = when formulated and in percentages—Fe_2Cl_3, 1·3; FeO,SO_3, 0·8; $Fe_2O_3.3SO_3$, 22·9; $Fe_2O_3,2SO_3$, 18·2; water, 56·8. Sample marked L contained, in 100 parts—Peroxide of iron, 20·10; sulphuric acid, 19·74; hydrochloric acid, 3·96; nitric acid, 2·18; water, 54·02 = formulated and percentically—Fe_2Cl_3, 5·86; $Fe_2O_3,3NO_5$, 3·25; $Fe_2O_3,3SO_3$, 17·95; Fe_2O_3, $2SO_3$, 17·94; HO, 55·0. Sample marked T—Peroxide of iron, 18·04; sulphuric acid, 21·69; hydrochloric acid, 1·68; nitric acid, 1·12; water, 54·47 = Fe_2Cl_3, 2·50; $Fe_2O_3,3NO_5$, 1·67; $Fe_2O_3,3SO_3$, 27·15; $Fe_2O_3,2SO_3$, 10·80; water, 57·88. The sp. gr. of all these samples was exactly 1·525. This lengthy paper contains, further, very valuable information on the use, the best mode of manufacture, and the best methods of analysis and practical assay of this material,

which is especially used to increase the weight of silk when that material is to be dyed black or blue of certain shades.

Methods of Research in Water Statistics.—Dr. H. Trommsdorff.—Under this title, the author gives a treatise on water analysis, divided into the following sections:—Hydrotimetry, description of the apparatus for measuring and preparation of the titrated soap solution; estimation of total hardness; estimation of the carbonate and sulphate of lime, of the magnesia salts, and of the free carbonic acid; estimation of the permanent hardness; estimation of the magnesia salts; description of the hydrometrical method of the estimation of the total sulphates; estimation of chlorine; estimation of organic substances; general preliminaries; preparation of volumetrical solutions; description of the application of these solutions; estimation of ammonia; colorimetrical estimation of ammonia; preparation of Nessler's test, and of a standard solution of chloride of ammonium; estimation of nitrous acid; estimation of nitric acid.

Precipitation and Estimation of Manganese by Hydrosulphuret of Ammonium.—Dr. A. Classen.—This paper is a lengthy series of tabulated results of volumetrical experiments made under the following headings:—Behaviour of mono-hydrosulphuret of ammonium with a solution of manganese in the presence of chloride of ammonium; behaviour of poly-hydrosulphuret of ammonium solution with a precisely similar solution; behaviour of mono-hydrosulphuret of ammonium containing free ammonia with a precisely similar solution of manganese; behaviour of poly-hydrosulphuret of ammonium containing free ammonia with a solution of manganese containing chloride of ammonium; behaviour of mono-hydrosulphuret of ammonium with a solution of manganese containing variable quantities of chloride of ammonium and free ammonia; behaviour of poly-hydrosulphuret of ammonium with manganese solutions as foregoing.

Utilisation of the Liquids containing Molybdic Acid from the Residues of Phosphoric Acid Estimation.—Dr. F. Muck.—The acid liquors, the filtrates from the yellow precipitate, are mixed with the ammoniacal wash-waters from the ammonio-phosphate of magnesia precipitates, and in addition, there is added phosphate of soda solution, in the proportion of 1 part of phosphoric acid to 30 of molybdic acid; after which, the fluid is left at rest for twenty-four hours in a warm place. The precipitate is collected on a filter and washed, until the filtrate begins to run slightly turbid; the precipitate is next dried in a water-bath, and next dissolved in ammonia (360 parts to 100 of precipitate) and this solution is poured into nitric acid (1350 parts) into which, previously, from 2 to 3 parts of pure magnesia have been dissolved. The ensuing precipitate of ammoniacal phosphate of magnesia is next removed; and, after having been standing for some time, in order to give time for a small quantity of phosphate of molybdenum to settle down, the solution is fit for use again as molybdate of ammonia.

Concentrated Sulphuric Acid, a Test for Molybdic Acid.—Dr. Schönn.—When molybdic acid, or the ammonia, soda, lead, or baryta salts of that acid are heated in a porcelain capsule, with just sufficient sulphuric acid to moisten the material, of which only a few small bits (less than two milligrms.) suffice for the experiment, there will be observed the appearance of a blue, ultramarine-like colouration, which disappears again when the sulphuric acid is evaporated. When quantities of 10 milligrms. and upwards are acted upon, the blue colour is evidenced, even at the ordinary temperature, but it is best to add a few drops of alcohol. A solution of molybdic acid has to be first evaporated to dryness, and the native sulphide of molybdenum must be first converted into molybdic acid, before this most sensitive test can be applied; neither titanic, tungstic, or vanadic acid exhibit this phenomenon when similarly treated with sulphuric acid.

Fusion of Substances with Sodium or Potassium.—Dr. Schönn.—A lengthy paper on some methods of fusion and ignition whereby sodium (being the cheapest) is applied to disintegrate and decompose, at a high temperature, various substances. We regret that the paper is not suited for useful abstraction.

Estimation of Uranium.—Dr. C. Winkler.—The author reviews and criticises Patera's labours on this subject, and chiefly points out some mistakes made in his calculations, as published in a former volume of this periodical.

Direct Estimation of Valerianic Acid in Valerianates.—A. Zavatti and F. Sestini.—Since the method of quantitative estimation here proposed and described is acknowledged and admitted by the authors to be invariably attended with a loss of at least 6 per cent of the substance to be estimated, we need not enter into details on this subject.

Phenylate of Potassa as a Test for the Presence of Water in Ether.—J. Romei.—Perfectly dry phenylate of potassa is quite insoluble in anhydrous ether, but partly dissolves in that liquid when containing water, and then imparts to it a reddish brown colour. The author found that, even when the ether contains only 2·5 parts of water in 1000 of ether, the test is perfectly perceptible.

Reduction of Small Weights.—Dr. K. L. Bauer.—An algebraical essay.

Composition of Atmospheric Air at Various Heights.—Dr. K. L. Bauer.—This paper contains a series of cypher figures derived from a formula (algebraic) as given by V. Regnault.

Behaviour of Sodium and Magnesium with Substances, and especially Liquids, which contain Sulphur.—Dr. Schönn.—After briefly referring to a former paper on this subject, the author now states that, instead of sodium, pulverised magnesium can be used for the detection of sulphur, in the following manner:—The substances to be tested (for instance, the sulphates of lime or baryta) are thoroughly mixed, previously reduced to powder, and next heated to redness with the metal in a test-tube made of thin hard glass. After the reaction is over, the contents of the tube are, when quite cold, treated with distilled water and tested with nitro-prusside of sodium; organic substances—*e.g.*, previously-carbonised albumen—may be tested in the same manner for sulphur. As regards liquids containing sulphur, the author states that a drop of sulphuric acid, when brought into contact with sodium, yields, among the products of the reaction, sulphuret of sodium; with magnesium, this reaction does not take place unless heat be applied. Sulphide of carbon and essential oil of mustard may be readily proved to contain sulphur by application of the same test.

Very Simply-Constructed Small Sulphuretted Hydrogen Gas Apparatus.—G. Hinrichs.—Illustrated with a woodcut essentially necessary for the proper understanding of the description.

Quantitative Estimation of Carbon in Pig-Iron.—Dr. R. Fresenius.—The weighed quantity of iron to be tested for carbon is placed on a small porcelain boat and introduced into a hard glass combustion-tube, placed in a combustion-furnace, and, when red-hot, a current of dry chlorine gas (dried by making it pass over pieces of pumice-stone moistened with strong sulphuric acid) is passed over; the current of gas and application of a low red heat is continued until all the iron is volatilised as chloride. The carbon left in the small boat is, after the apparatus has cooled, placed in a porcelain tube and burned. After being heated to redness in a current of oxygen, the products of the composition are taken up by Liebig's potash-bulbs. Great care is required that the chlorine be thoroughly dry, since, otherwise, hydrocarbons may be formed and some carbon lost.

Behaviour of the Vapours of Nitrous and Hyponitric Acid when Daylight passes through them.—Dr. E. Luck.—This paper contains a series of observations on the spectra exhibited by these substances.

Absorption-Spectrum of Perchloride of Manganese (Mn_2Cl_7).—Dr. E. Luck.

Behaviour of Hypochloric Acid with Brucine and its Salts, and on the Value of the Reaction of Brucine for Detecting Small Quantities of Nitric Acid.—Dr. E. Luck.—The main point of interest of this paper is the fact that, when brucine comes into contact with hypochloric acid and free sulphuric acid, there appears a highly-red colouration, which disappears on the addition of tin-salt. The use of brucine for the detection of nitric acid is, according to the author's researches, not very reliable, and less distinct than the reaction of phenol-sulphuric acid with nitric acid.

Solubility of Cream of Tartar (Bitartrate of Potassa) in Aqueous and Alcoholic Fluids; Testing of the Berthelot Fleurien Method for the Quantitative Estimation of that Salt, and of Tartaric Acid, in Wine.—E. Kissel.—This lengthy paper, and the following—

Estimation of Acetic Acid in Wine—E. Kissel—Are too extensive for useful abstraction, and, moreover, chiefly interesting in vine-growing and wine-producing countries.

Composition of the Carbonates of Manganese.—E. Prior.—The author describes, at very great length, a series of experiments in order to elucidate the real composition of carbonate of manganese, prepared in different ways and with pure materials, and with precautions as regards its alteration by oxidation. The precipitate produced in a solution of pure and neutral sulphate of manganese by the addition of carbonate of ammonia is, after very careful drying *in vacuum*, composed, in 100 parts, of—MnO, 57·25; CO_2, 35·48; HO, 7·27. Formula, $2(MnO,CO_2)+HO$. The precipitate produced by carbonate of soda in solutions of salts of protoxide of manganese is composed, in 100 parts, of—MnO, 61·73; CO_2, 38·27. The precipitate, however, of carbonate of manganese, as usually obtained by precipitating a proto-salt of that metal with carbonate of soda, was found to consist, after drying at 60°, in 100 parts, of—MnO, 62·11; CO_2, 37·89.

Action of Boiling Saline and other Solutions upon Vessels of Glass and Porcelain.—W. Casselman.—This very lengthy paper contains the results of an extensive series of experiments, from which the following general results are derived:—Water and acids hardly, if at all, act upon good porcelain vessels; the fixed alkalies attack porcelain, but less so than they do glass, which is far more readily and generally acted upon by the substances alluded to, as well as by saline solutions.

Journal de Pharmacie et de Chimie, March, 1870.

This number contains the following original papers and memoirs:—

Two Products of the Boletus Laricis (a kind of Mushroom).—G. Fleury.—The author has separated from this, previously dried and pulverised, cryptogamic plant, a resinous substance, insoluble in water; soluble in ether, absolute alcohol, chloroform, and acetic acid; insoluble in benzol and sulphide of carbon; and fusing at 89·7°. Caustic potassa solution and ammonia take up this body, yielding solutions which froth very strongly. This resin consists, in 100 parts, of—Carbon, 71·6; hydrogen, 9·6; oxygen, 18·8; its barium compound is $C_{51}H_{82}BaO_{11}$. Agaricic acid, a white crystalline body, fusing at 145·7, soluble in alcohol, but hardly soluble in water or ether. Percentage composition—Carbon, 64·0: hydrogen, 9·3; oxygen, 26·7.

Preparation and Properties of Hydrate of Chloral.—J. Personne, and—

Report on Some Facts relating to the History of the Hydrate of Chloral.—MM. Roucher, Lebaigue, and Jungfleisch—Are, although valuable, strictly pharmaceutical papers.

Search for Cyanhydric Acid in Tobacco Smoke.—Drs. Poggiale and Marty.—Since Dr. Vogel, in Germany, had stated that he had very readily detected cyanhydric acid in tobacco smoke, by means of Schoenbein's test-paper for that acid, the authors have very carefully conducted a series of experiments, by means of aspirators, with tobacco (200 grms. at a time) placed in the bowl of a large pipe, and have tested the smoke, as well as the tarry and oily products of the combustion of tobacco, with the following results:—Tobacco smoke does not contain any hydrocyanic acid; neither is any found in the other (condensed) products of the combustion of tobacco. The authors also state that Schoenbein's prepared paper for the detection of cyanhydric acid is not reliable for that purpose; while they have applied proper tests, and compared these with fluids to which either cyanhydric acid or cyanides had been purposely added.

Les Mondes, March 31, 1870.

Decrease of the Temperature of the Air in relation to the Elevation above Sea Level.—Dr Hann.—This author has tried to solve, experimentally, or, rather, by observation, the problem of the decrease alluded to by comparing the average of temperature, as observed at certain groups of stations situated under the same mean latitude and longitude, and by taking into account local influences. Seven of these groups are situated in the western portion of the Alps, at from 230 to 3,330 metres above sea level; four in the northern part of Switzerland, at from 500 to 1780 metres above sea level; three in the Rauhe Alps (Wurtemberg), at from 310 to 810 metres above sea level: four in the Ezgebirge (Central Germany), at from 180 to 850 metres above sea level; and four in the Harz (province of Hanover and Brunswick), at from 70 to 1140 metres above sea level. The results obtained have proved that, in the instances mentioned, the decrease of the temperature of the atmosphere near to the ground is really proportionate to the height of the locality above sea level. When the results of all the observations are duly considered, there is discovered to exist a very strongly-marked annual periodicity, and a very uniform decrease of temperature from below to above, the average relation of the temperature reigning in December being, to that of June, as 1 to 2.

Bayerisches Industrie und Gewerbe Blatt, January and February, 1870.

These numbers contain, as usual, the full texts of a great number of official communications, chiefly of local importance, and, in addition thereto, the following papers relating to chemistry and collateral sciences:—

Supply and Quality of the Water Used for Domestic Purposes to the City of Munich.—Dr. A. Wagner.—It appears, from this paper, that the capital of Bavaria is exceedingly well off, both as regards the sources of supply, the quantity and quality of the water, which is very pure, containing, as it does, only from 0·16 to 0·60 grms. of solid matter (organic inclusive) to the litre of fluid.

Substitute for Copper for the Daniell Electric Battery.—Dr. C. Stölzel.—The author says—Take a piece of well-polished tin-plate (sheet tin, not tinned iron), immerse it in a very dilute solution of a copper salt, and put it in connection with a weak galvanic current. After the lapse of from fifteen to eighteen hours, a layer of strongly-adhering metallic copper will have become firmly deposited upon the tin-plate; and the latter, after having been bent into the required shape, is an excellent, cheap, and durable substitute for the copper cylinder in Daniell's battery.

Collieries near Miesbach, Upper Bavaria.—F Hailer.—An excellent monograph, from which it appears that, as far back as the year 1447, pit-coal was known, and in use (limited, however), in that district.

Albolith.—W. Riemann.—Under this name, the author

prepares a cement chiefly consisting of magnesia. For this purpose, the magnesite of Frankenstein (Silesia) is ignited in retorts similar to those used for gas manufacture; and, after the mineral (a native carbonate of magnesia) has been ignited, it is mixed with silica and some other substances not specified. This mixture has the property of yielding, with moderately-concentrated solutions of chlorides (for instance, chloride of magnesium), a most extremely plastic, but, on drying, a very hard material, excellently adapted for use as cement for stucco and ornamental work, and instead of gypsum.

These numbers also contain the programme of a General Industrial Exhibition intended to be opened at Cassel (Prussia) in June next. The object of this Exhibition is very similar to that held at Amsterdam last year.

Journal für Gasbeleuchtung, February, 1870.

This number contains—

Regulations for the Inspection and Testing of Gas Meters for the Grand Dukedom of Oldenburg.

Collection of Facts relating to the Supply of Potable Water for Altenburg, Berlin, Zurich, and a large number of Cities and Towns of Germany, Austria, Hungary, and Northern Italy.

Polytechnisches Journal von Dingler, first number for February, 1870.

The number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Thermometer and Pyrometer Provided with Automatical Electric Signalling Apparatus.—O. Zabel.—This paper is illustrated with a series of engravings absolutely required for the proper understanding of the useful contrivances herein described.

Combined Areometer.—Dr. H. Bardeleben.—This lengthy memoir, also illustrated with an engraving, describes an instrument—an ingenious combination of the scale and the weight areometer—whereby the determination of the specific gravities of solid bodies is rendered easily performed, while the instrument serves, at the same time, the purposes of the areometers in ordinary use.

Application of Gas to Blast Furnaces.—F. Lürmann.

On Rapakiwi as a Suitable Material of the Manufacture of Bottle-Glass.—H. G. Benrath.—The material known in Finland (a portion of the Russian Empire) as rapakiwi, and wrought in the quarries of Pyterlak, consists, in 100 parts, of—Silica, 74·24; alumina, 12·13; peroxide of iron, 2·88; lime, 0·90; magnesia, 0·19; potassa, 6·68; soda, 2·50; water, 0·04. The author describes, further in his paper, a series of experiments made with the view to ascertain the most suitable materials, and the quantities thereof, to be mixed with the mineral (a kind of granite used for building and ornamental purposes, especially in St. Petersburg) in order to form good glass.

Utilisation of Exhausted and Sliced-Up Beet-Roots as Fodder.—Dr. C. O. Tech.—This paper is chiefly interesting to beet-root sugar makers who apply the so-called Robert's method of juice extraction.

Second February number.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Improved Pyrometer.—C. Bock.—To this paper and the following—

Control Thermometer—Th Oechelle—The engravings are required for the proper understanding of the subjects described.

Changes and Alterations Coal Undergoes by Exposure to Air.—Dr. E. Richters.—We can only quote the titles of the different sections this highly-interesting paper has been divided into, viz.:—Chemical process of the oxidation of coals; influence of heat on the process of oxidation; influence of moisture upon the oxidation; influence of light upon this process.

Possibility of the Application of Gas to Blast Furnaces.—C. Schinz.

Bleaching of Wool.—Dr. H. Grothe.

Activity (Wirksamkeit) of Amorphous Phosphorus for Safety Matches.—W. Zettel.—A paper of special interest only to lucifer match makers.

Schlickeysen's System of Improving Peat.— R. Schmidt.

Coating of Brass with Bismuth.—C. Puscher.—Add to a solution of nitrate of bismuth, made with 16·66 grms. of that metal, 33·32 grms. of purified cream of tartar dissolved in boiling water, and add from 50 to about 67 grms. of previously-pulverised bismuth. Place the brass objects to be coated over into this fluid while boiling, and, in a short time, a brilliant silvery white strongly and firmly-adhesive coating of bismuth will be deposited.

Comptes Rendus des Séances de l'Académie des Sciences, April 4, 1870.

Leaving the purely mathematical, mathematico-physical, and similar papers, as also those belonging to natural history, unmentioned, this number contains the following papers relating to chemistry and collateral sciences:—

The Teacher of Descartes.—M. Jouglet.—The author has discovered, in the Municipal Library, at Tours, an unpublished manuscript bearing title, "In Universam Logicam Moralemque Philosophiam Commentarius Authore Celeberrimo Professore Grandillonio, ex convictu Flexensi," 1619. It is a well-known fact that Descartes (Cartesius) was educated at the College at La Flèche, but his teacher's name had not hitherto been found out. The author of this paper states that the manuscript is of great value, and deserves to be printed for public use.

Existence of Selenium in Commercial Copper.—Ch. Violette.—In order to detect the presence of this metalloid in copper, the author oxidises the metal, previously suitably cut up, by heating it to redness in a muffle. The oxide obtained is next placed in a combustion-tube, and then placed in a gas or other furnace (as applied for elementary organic analysis), and heated to strong red heat for several hours in a current of dry and pure air freed from aqueous vapour and carbonic acid. If any selenium be present, there will appear, at the cooler portion of the tube, just outside in front of the furnace, a white-coloured ring, composed of a volatile, crystalline, very hygrometric substance, readily soluble in water, and not coloured blue on addition of ammonia, which indicates absence of copper. The aqueous solution yields an abundant precipitate with nitrate of silver, which is soluble in excess of nitric acid. Reducing agents turn this white-coloured ring into a red-coloured substance, which exhibits all the reactions of selenium. The copper operated upon was from Chili.

Cause of the Acidity of the Water Collected in the Chloride of Calcium Bulbs Fixed to the Apparatus in Use for Elementary Organic Analysis.—Ch. Violette.—The author's researches prove that the acidity alluded to is due, partly to hydrochloric acid, and partly to selenious acid; the former being due to the omnipresence of hydrochloric acid in the air of chemical laboratories, and, as regards the latter, the cause has just been explained.

Formation of Formic Acid from Carbonic Acid.—E Royer.—The author states that, while submitting to the action of a current of electricity an aqueous solution of car-

bonic acid, the latter was simply, by the addition of hydrogen, converted into formic acid.

General Theory of Chemical Action.—M. Maumené.—Of this memoir, which was not read, the Perpetual Secretary on duty at the meeting said that it contained a critical review of the labours of MM. Friedel and Crafts on siliciumethyl.

Laws which Regulate the Expansion of Gases.—J. Dubrunfaut.—One of the most prominent points of this lengthy paper is the statement made by the author that even the driest air, or any other gas, contains always 5-10,000ths part of a gramme of aqueous vapour to the litre.

Object-Glass Provided with a Prism to be Used with an Ophthalmoscope.—M. Wecker and G. Roger.—By the contrivance of a prism for total reflection, the authors enable two parties to make observations simultaneously.

Application of Polarised Light to the Photographing of Microscopically-Small Crystals of some Salts.—J. Girard.—There was no paper read on this subject, but the photograms were exhibited.

Newly-Published Work.—H. de Parville.—M. J. Dumas highly eulogises the volume just published under the title of "Causeries Scientifiques," (Scientific Gossip). The eminent author reviews the recently-made progress in divers branches of science, and the applications thereof.

Although not belonging to chemistry or collateral sciences, we quote the title of the following paper, chiefly because France is indebted to M. J. Dumas for instituting this very useful *enquête* while he (now some 20 years ago) was the Minister of Agriculture, Commerce, and Public Works.

Communication of the Cases of Rabies which have Occurred in France during the Sexennial Period, of 1863 to 1868 inclusive.—M. Bouley.

Revue des Cours Scientifiques de la France et de l'Etranger, April 2, 1870.

This number does not contain any original papers or memoirs relating to chemistry or collateral sciences.

Revue Hebdomadaire de Chimie, March 24, 1870.

Description of an Apparatus Suited for Heating Molasses.—Lefèvreef Lévbre.—This apparatus, illlustrated by a woodcut, the author states, is highly economical, in consequence of the very small consumption of fuel, and that this apparatus is now being introduced for the heating of wines ccording to Pasteur's system.

Refining of Raw Sugars, and Extraction of Crystallisable Sugars from Molasses, by means of the Sucrate of Hydrocarbonate of Lime.—MM. Boivin Loiseau.—This paper, although not a reproduction of another on the same subject, and already alluded to by us, partakes of the same defect, viz., of not lucidly and clearly describing the process, and of not in the least explaining what sucrate of hydrocarbonate of lime is, or how it is prepared.

New Process for the Preparation of Nitric Ether.—H. Lossen.—Nitric acid (sp. gr., 1·4) is heated with nitrate of urea (15 grms. to the litre) to boiling-point, and next left to become cold. 400 grms. of that acid are then taken and mixed with 300 grms. of absolute alcohol; and thereto is added 100 grms. of nitrate of urea, and this mixture distilled from a tubulated retort. When about half the contents of the retort have been distilled over, a fresh portion of alcohol and acid is added, by means of a proper funnel-tube. The 100 grms. of nitrate of urea are sufficient for obtaining 7 litres of this ether.

Moniteur Scientifique, No. 319, April 1, 1870.

This number contains the following original papers and memoirs relating to chemistry and allied sciences:—

Researches on the Ethers of Boracic Acid.*—H. Schiff.—This most extensive monograph is divided into the following sections, the titles of which we can only quote, since the work is not suited for any useful abstraction. In the introduction, the author discusses boracic acid, of which he assumes the existence of monoboric, biboric, triboric, tetraboric, and polyboric acids, illustrated by a series of complicated formulæ. We next have—Triethylic borate; monethylic borate; monethylic triborate; Ebelmen's boric ethers; methylic derivatives of boric acid; amylic derivatives of boric acid; mixed ethers of boric acid; monomethylic borate; boric anhydride and glycerine; boric anhydride and phenic alcohol; monophenic borate; tetraphenic diborate; boric anilide; supposed combination of chloride of boron and ether.

Adulteration of Catechu.—J. Tissandier.—It is a well-known fact that catechu is too often adulterated; and the sophisticated substance has often injuriously affected various operations wherein it is employed, especially dyeing and calico-printing. According to this author, genuine catechu, when exhausted by means of ether, loses 53 per cent of its weight, leaving, after drying, 47 per cent of residue. A mixture of catechu and alum gives a white precipitate with nitric acid and with chloride or barium.

Neues Jahrbuch für Pharmacie, von Dr. F. Vorwerk, January, 1870.

This number contains the following original papers and memoirs relating to chemistry and collateral sciences:—

Estimation of the Value of the Various Kinds of Cinchona Bark.—Dr. A. E. Vogl.—Forty grms. of the previously-pulverised bark are intimately mixed with 10 grms. of quick-lime, and made into a thin paste with water; and this mixture is dried (the temperature is not stated). The dried mass is pulverised, and repeatedly exhausted with boiling alcohol at 90 per cent (600 c.c. are a sufficient quantity for this purpose; the alcoholic solution is filtered, and to the filtrate are added about 5 c.c. of dilute sulphuric acid. The ensuing precipitate of gypsum having been removed by filtration, the alcoholic fluid is submitted to distillation, and, after having been greatly reduced in bulk, is further evaporated to a very small bulk on a water-bath, whereby, a flocculent, resinous, vanilla-like smelling aromatic substance is precipitated. After this material is again removed by filtration, to the filtrate is added a sufficient quantity of a solution of caustic soda as is required for the precipitation of all the alkaloids contained in the bark. These bodies are, by this mode of treatment, obtained in a high degree of purity in the shape of a white caseous, or crystallino-flocculent precipitate; this should be collected on a previously-tared filter, washed with the smallest possible quantity of water, and thoroughly dried, and next weighed. In order to separate the different bases from each other, the aforesaid precipitate is digested for twenty-four hours in a small flask with about 5 c.c. of ether. The ethereal solution is filtered off from the insoluble residue, which is first washed with ether, and next dissolved in alcohol. Each of the solutions so obtained is evaporated, yielding, in some instances, an amorphous, in others, a crystalline residue. These residues are dissolved in dilute sulphuric acid; and, after these solutions have been filtered, the alkaloids are precipitated from these solutions by means of a caustic soda solution, which has been titrated so as to correspond with the dilute sulphuric acid applied as just stated. This method of the estimation of the value of the cinchona barks is recommended by the author for the reason—(1) that it is easily and rapidly executed; (2) because it affords complete exhaustion of the valuable constituents of the bark, with very little, if any, loss; (3) because the bases are obtained directly in a high degree of purity. There are appended to this paper a series of results of analyses of various kinds of barks, made partly by this

* This paper is not, in the strict sense, original, but, since it has been only published in the *Giornale di Scienze Naturale ed Economiche di Palermo* (vol. v., p. 9,) we quote it here.

and partly by other well-known methods, as devised by scientific men who, like Dr. D. Vrij, Dr. Rabourdin, and Prof. Schneider, are high authorities on this subject. From the results here published, this method deserves every praise.

On Arsenic-Free and Arsenic-Containing Aniline Colours.—Dr. Werner-Ertel.—The main gist of this paper, which contains some rather startling and curious, yet, unfortunately, not properly specified, statements, in respect of the extensive dissemination of arsenic in some of the German rivers, as a consequence of the large consumption of arsenic in the preparation of aniline colours, is, how to obtain fuchsine, and other similar preparations, free from arsenic, so as to render these substances fit for the colouring of sweetmeats, liqueurs, syrups, and pharmaceutical preparations.

Preparation and Qualitative Testing of Hydrate of Chloral.—Dr. Riecker.—A lengthy, but purely pharmaceutical paper.

Very Simple, but rather Rare, or Hitherto Undetected, Adulteration of Saffron.—Dr. W. Hallwachs.—The author states that, when he was, towards the end of last year, performing his duty as Inspector of Pharmacy and Pharmaceutical Chemists' Shops, he met with two instances of saffron having been adulterated with chalk; a fraud, he says, not so readily perceived as would appear, since it is only found out by taking a rather large quantity of the drug and placing it in water. Upon stirring the mixture, the chalk settles down on the bottom of the vessel, and may, of course, after having been washed with water, be readily tested. The author estimated the quantity in one instance, and found 17·5 per cent by weight; he also states that, in his opinion, this adulteration of this always rather expensive drug is made at the places where the saffron is grown, in order thus to increase the weight.

Decomposition of Ammonio-Phosphate of Magnesia.—Dr. N. Graeger.—The author states that he is in the habit of keeping a concentrated aqueous solution of this salt for the purpose of washing therewith the precipitate of the same salt obtained in well-known analytical operations. The aqueous solution alluded to, not having been required for use for at least six months, the author, on requiring it again, was astonished to find that, on the surface of the liquid, as well as on the layer of the salt at the bottom of the bottle, there was a film of pale golden-yellowish coloured substance; on opening the vessel which contained the solution, a very strong smell of phosphuretted hydrogen appeared. The quantity of the coloured material alluded to was too small to test even qualitatively, but the author thinks it might be phosphide of magnesium. The distilled water used for making the solution was pure, but not quite free from a small quantity of organic matter.

Annales de Chimie et de Physique, March, 1870.

This number contains the following original papers:—

Researches on Camphor, and on some of its Derivatives.—H. Baubigny.—Continuation and end of a very lengthy paper.

New Theory of the Electro-Dynamic Action.—M. Reynard.—An algebraico-physical essay.

Researches on the Combinations of Silicium with the Alcohol Radicals.—C. Friedel and J. M. Crafts.—This memoir is divided into the following sections:—Silicium-ethyl; oxide of silicium-triethyl; action of bromine on silicium-ethyl; action of bromine and iodine (jointly) on silicium-ethyl; action of iodine on silicium-ethyl; action of chlorine on silicium-ethyl; acetate of silicononyl; siliconylic alcohol; constitution of silicium-ethyl-bichloride; oxidation of silicium-ethyl; silicium-methyl; silicium-ethyl-methyl.

Experimental and Theoretical Researches on the Equilibrium Figure of a Liquid Mass which is considered as Devoid of Weight.—J. Platcau.—Conclusion of a very lengthy and abstruse, yet very valuable, paper on this subject.

Bulletin de l'Académie Impériale des Sciences de St. Petersbourg, vol. xiv., No. 4.

This number contains only one paper relating to chemistry—

Some of the Properties of Galvanically-Precipitated Iron.—R. Lenz.—This lengthy paper records a series of experiments, not only made with iron, but also copper. The results are stated as follows:—Iron and copper, when reduced to the metallic state by electricity, contain gases occluded, among which, hydrogen is in largest amount; the bulk of gas thus occluded varies considerably, but iron has been found by the author to occlude as much as 185 times its own bulk. The absorption of the gases is more considerable in the first layers of metal deposited. On being heated the iron loses gas, even below 100°, the gas evolved at so low a temperature being chiefly hydrogen. Iron which has been galvanically precipitated, and then made red-hot and cooled, becomes oxidised when put into water, that liquid being decomposed and hydrogen given off.

Bulletin de la Société d'Encouragement pour l'Industrie Nationale, No. 206, February, 1870.

This number is almost entirely filled with a lengthy report of the General Annual Meeting of this Society held on the 11th of February last, under the presidency of M. J. Dumas. Among the reports of the prizes and medals given to a very large number of parties, the following may be noticed as being of general importance:—

Distillation of Beet-Root in the Rural Districts, as carried out by M. Champonnois's System, to whom the Argenteuil Prize of £500 is given.—M. Heuzé.—This is an excellent paper on a rural industry now of very great importance, not only for the production of alcohol, but also for fodder for cattle and the supply of farmyard manure.

Pyro-Electric Gilding Invented by M. Masselotte, to whom a Prize of £20 has been given.—M. Barral.—From the author's report, it appears that this invention is very valuable, since it possesses all the advantages of the best method of mercurial gilding, without being at all detrimental to the workmen.

Improvements in the Methods of the Preparation of Extracts from Dye-Stuffs, by M. Coez, to whom a Gold Medal has been awarded.—This process is briefly alluded to, having been already fully described some three years ago. From what is here stated, the extracts prepared by this method are in high reputation at Mulhouse, Rouen, and Lyons.

Animal Phosphated and Chlorinated Manure.—A silver medal has been awarded to Dr. Grouallo and Dr. Boucherie for having successfully solved the problem of utilising dead cattle—viz., dying a natural death, and converting the carcases, in a very short time, to an excellent manure—saving the fat, and obviating any nuisance.

Annalen der Physik und Chemie, von Poggendorff, No. 2. 1870.

This number contains the following original papers:—

Thermo-Chemical Researches.—J. Thomsen.—The fourth and final part of this monograph, subdivided into the following sections:—Boric acid; silicic acid; stannic acid; titanic acid; platinic acid (*platinsäure*); the fluorides of boron, silicium, titanium, tin, and platinum.

Circular Polarisation in some of the Six-Membered (Sechsgliedrigen) Hyposulphates.—C. Pape.

Some Peculiarities Relating to the Theory of the Capillary Phenomena.—J. Stahl.—A mathematico-physical essay.

On the Part Capillarity Plays in the Phenomena of the Spreading Out (Ausbreitung) of Liquids.—P. du Bois-Reymond.

Observations and Remarks upon Two Memoirs, by MM. von Bezold and E. Edlund, on Electrical Phenomena.—R. Clausius.

Historical Observation on the Publication of G. Magnus treating on the Reflection of Heat.—H. Knoblauch.

Relations Existing between the Changes of Bulk during the Formation of Solid Compounds and the Chemical Affinity of the Component Substances.—W. Müller.—Chiefly a series of tabulated forms, unsuited for any useful abstraction.

Preparation of Crystallised Silicic Acid by the Dry Way.—G. Rose.—The author records a series of experiments, chiefly of interest for mineralogy, as elucidating the formation of native crystalline silica.

Enstatite occurring in the Meteoric Iron of Breitenbach (Bohemia).—V. von Lang.—A purely crystallographical paper.

Crystalline Form of Hypersthene.—A. von Lang.—Also a crystallographical paper. Hypersthene is a mineral composed of silica, alumina, protoxide of iron, protoxide of manganese, magnesia, lime, and water.

Contribution to the Ozone Question.—O. Wolffenstein.—This essay is illustrated with engravings absolutely required for the proper understanding thereof.

Researches on the Compounds of Selenium and Sulphur.—A. Bettendorff and G. vom Rath.—This paper is chiefly a crystallographical essay respecting some compounds artificially obtained, the results of analysis of which are only approximatively given.

Electrical Action of Points (Spitzenwirkung).—Dr. J. C. Poggendorff.

Corroded Figures (Aetzfiguren) and Asterism in Iceland Spar.—Dr. H. Baumhauer.

Journal für Praktische Chemie, Nos. 22 and 23, 1869.

These numbers contain the following original papers and memoirs:—

Contribution to our Knowledge of Selenium.—Dr. B. Rathke.—This paper, a continuation of an essay on this subject, contains the following sections:—Estimation of selenium in organic compounds: carbide of selenium and selenium-xanthogenic acid; experiments for the preparation of selenium-tetrethyl and sulpho-tetrethyl; ethyl-selenious acid; observations concerning the organic derivatives of sulphurous and selenious acids, and also of sulphuric and selenic acids.

Ratanhine and its Combinations.—Dr. W. F. Gintl.—The commercial extract of rathannia contains a principle called ratanhine. The author, in the introduction to his paper, states that the substance known as angelin, and met with in the *Ferreira spectabilis*, is identical with ratanhine; and he has made use of that material (angelin) to prepare and analyse a lengthy series of compounds, among others, *ratanine ammonia*, no properly-speaking constant compound of ammonia; and the substance named could be obtained, and different formulæ are quoted relating to the higher or lower temperatures at which the *pro tempore* existing compound was prepared, 0° (32° F.). The formula is $C_{10}H_{13}NO_3+19NH_3$. Dry ratanhine does not combine with ammonia at all, if the latter be applied in the state of dry gas. There are further described a series of experiments to form compounds of ratanhine with the alkalies, soda and potassa, with baryta, strontia, lime, magnesia, and the oxides of heavier metals; the silver compound is $C_{10}H_{11}Ag_2NO_3$; behaviour of ratanhine with acids; and, lastly, speculative discussions on the constitution of ratanhine.

No. 1, 1870.

With this number begins a new series of volumes of this periodical which is edited by Dr. H. Kolbe. The number opens with a table of the numbers of the equivalents of the elements and some of their compounds, it being, of course, understood that the several authors who are contributors to this paper may make use of such equivalents as they prefer; but, unless the contrary is distinctly stated, the table here referred to is the one adopted for this periodical. We next meet with a very lengthy series of the titles and abbreviations thereof of the various scientific periodicals, as they will be quoted henceforward in this work. The present number opens with a lengthy essay on the—

Task and Scope of Mineral Chemistry.—H. Kolbe.—Not at all suited for abstraction.

Identity of Naturally-Occurring Leucine with that obtained by Synthetical Methods of Preparation.—Dr. G. Hüffner.—A physiologico-chemical paper, the leading point of which is that all the three known leucines, and obtained by different methods, are identical, and not simply isomeric.

Some of the Derivatives of Oxysulpho-Benzide.—J. Annaheim.—This paper is divided into the following sections:—Ethyl-oxysulpho-benzide; nitro-ethyl-oxysulpho-benzide; tetra-chloroxysulpho benzide.

Isomeric Succinic Acids.—H. Byk.—A very lengthy monograph, too full of formulæ to admit of any useful abstraction.

Crystalline Forms of Trithionate and Seleno-Trithionate of Potassa.—B. Rathke.—A crystallographical paper, illustrated with woodcuts.

Bibliothèque Universelle et Revue Suisse.—Archives des Sciences Physiques et Naturelles, No. 147, 1870.

This number contains the two following original papers, of which, although not exactly belonging to chemistry, we quote the titles:—

Evaporation of Water of the Soil and of Plants.—E. Risler.

Dust Floating about in the Atmosphere.—A. de la Rive.

Cosmos, April 2, 1870.

Preparation of Photographic Figures on Glass.—E. Siegwart.—This paper contains a detailed account of the various operations required for fixing upon glass various designs.

Experiments on the Freezing of Wine.—A. Rousselle.—The reason why freezing improves wines, under certain conditions, is, according to this author, because, by freezing the proportion of all the fixed substances (*éléments*) in wine is increased, and these are, moreover, thereby rendered more fit for causing the combination of the acids with the alcohol, so as to form those ethers to which wine owes its peculiarly distinct flavour, aroma, and strength.

Revue Hebdomadaire de Chimie, March 31, 1870.

New Plan for the Method of Estimating the Market-Value of Molasses.—M. Mène.—This paper, chiefly of interest to beet-root sugar makers, enters, at some length, into the application of the areometer for ascertaining the value of the molasses; and next, the author discusses the plan of estimating the value of the molasses according to the alcohol it yields, stating that 100 parts of sugar should produce, in practice, 57 parts of alcohol at 90 per cent.

Description of an Improved Barometer for Use in Chemical Laboratories.—M. Alvergnat.—The description is not available without the woodcut; but the instrument is undoubtedly a very suitable one for the use it is intended for.

Annalen der Chemie und Pharmacie, February, 1870.

This number contains the following original papers and memoirs:—

On Fermentation, and on the Source of Muscular Force.—Dr. J. von Liebig.—The continuation and end of the celebrated author's lengthy essay on this subject, divided into the following main sections:—Acetic fermentation the source of muscular power.

Experimental Researches made with the view to Elucidate the Causes upon which the Substitution of the Radical Hydrogen is made Dependent in Isomeric Butyric Acids.—Dr. Morkownikoff.—This very lengthy essay contains the following subdivisions:—Oxyisobutyric acid; researches on the different oxybutyric acids; the haloid hydrines of propylenglycol.

Some of the Alcohols of Fermentation and Derivatives thereof.—J. Pierre and E. Puchot.—Not well suited for any useful abstraction.

Comptes Rendus des Séances de l'Académie des Sciences, April 11, 1870.

This rather small number is chiefly taken up by papers relating to phyto- and zoo-physiology. The papers and memoirs relating to chemistry and collateral sciences are the following:—

Correction of the Name of a Late Very Celebrated Man.—Marshal Vaillant deposits several authentic records, from which it appears that the famous natural-historian, Cuvier, was born on August 23, 1769, at Montbéliard, and that his birth registered with the Christian names of Jean Léopold Nicolas Frédéric. The Christian name of Georges, by which, while living, this eminent man was known, is not on the official registers.

Action of Magnetism upon Two Electric Currents which are Made to Pass simultaneously through Space Containing Rarified Gases.—A. Daniel.

Experiments Made with the View to Elucidate the History of Nitric Acid.—E. Bourgoin.—The author's experiments, described at length, prove that by the reducing action of hydrogen upon nitric acid, $NO_52H_2O_2$, there are formed nitrous acid, deutoxide of nitrogen, nitrogen, and ammonia.

Metallic Tartrates.—M. Descamps.—The only tartrate described is the double tartrate of sesquioxide of manganese and potassa, $Mn_2O_3.KO,C_8H_4O_{10},4HO$. This salt is obtained by pouring a concentrated solution of bitartrate of potassa, at a temperature of 40°, upon sesquioxide, or, better yet, hydrated binoxide of manganese; the vessel wherein this operation is carried on should be cooled. The reaction results in the production of a deep red-coloured liquid, which deposits, after filtration and some days' standing, red-coloured crystals of the double salt; the solution referred to is readily decomposed by the action of heat. Even at as low a temperature as 50° or 60° this decomposition begins, but at a higher temperature it becomes violent and instantaneous, being accompanied by a sudden evolution of oxygen; the liquid then becomes colourless and only contains a salt of the protoxide of manganese. The red-coloured solution is neither precipitated by caustic nor carbonated alkalies; all reducing agents decompose this solution, and the decomposition is accompanied by decolouration of the liquid.

Aurora Borealis.—This number contains a valuable series of communications concerning an aurora borealis, observed on the 5th of April in various parts of France and Belgium, over a surface of country stretching from the sea eastward to the Rhine, and from Louvain, Leuven (Belgium), in the north, to no less a distance south than Annecy, in Savoy, the latter being a distance about equal to that from London to Edinburgh.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 2, 1870.

This number contains the following original papers and memoirs:—

Zirconium.—B. Franz.—The author describes first at some length the preparation of pure zirconia on a somewhat large scale by treating the native mineral with bisulphate of potassa, and the decomposition of the sulphate of zirconia, first by fusion with caustic soda, and next by treating the fused mass so obtained with sulphuric acid, and precipitating the zirconia from the aqueous solution of the sulphate by means of ammonia. Metallic zirconium was prepared by the decomposition of the fluoride of potassium and zirconium, $3KFl + ZrFl_4$, by means of aluminium and a high temperature. The metallic zirconium so obtained is not quite pure, and was found to consist, in 100 parts, of:—Zirconium, 98·34; aluminium, 1·03; and silicium, 0·17. The temperature required for this reduction so as to obtain crystalline zirconium is as least as high as that of the melting-point of copper.

Expansion of Water (Lecture Experiment).—F. Rüdorff.—In order to exhibit the effect of the expansion of water when freezing, the author fills with distilled and previously well-boiled and cooled water a cast-iron cylinder having the following dimensions:—Height, 160 m.m.; diameter (external), 50 m.m.; thickness of solid iron, 15 m.m. After having been filled with water this apparatus is closed by means of a plug screwed into the neck, and the cylinder is next placed in a mixture of 3 parts of snow or pounded ice, and 1 part of common salt; after about 40 minutes the cylinder bursts with a loud report. It is essential for the success of this experiment that the plug fits very perfectly, and that the cylinder, after having been filled with water, be placed for some time in ice. The wooden pail which contains the cooling mixture should be rather roomy, and be covered with a stout towel to prevent the spirting about of the contents at the time of the bursting.

Preservation of Zoological and Anatomical Preparations in Creosote-Water.—F. Holbein.—The main point of interest in this paper is that specimens collected during journeys may, after having been kept immersed for a shorter or longer time in creosote-water to be made extempore, be dried and packed as if they were minerals.

Mesohydromellitic and Tetrahydrophthalic Acids.—A. Baeyer.—Mesohydromellitic acid is difficultly soluble in cold, but readily so in boiling, water; it is a solid crystalline substance; at 130° it loses two equivalents of water, and becomes anhydride of mesohydromellitic acid, $C_{12}H_6O_{10}$. Tetrahydrophthalic acid fuses at 95°; the author states that he is engaged in further researches on this subject. This paper contains a series of very complicate formulæ which serve to illustrate the constitution of the bodies alluded to, but space forbids us to re-produce these formulæ here.

Withdrawal of Water (Wasserentziehung), and its Bearing upon Vegetable Life and Fermentation.—A. Baeyer.—This lengthy paper is divided into the following main sections:—Anhydride formation; condensation; phenomena of fermentation.

Products obtained from Crude Malt Spirits by Distillation.—G. Krämer and A. Pinner.—The authors first refer to some former researches on this subject, reminding that raw or crude spirits (a rather strong alcohol is alluded to) contains large quantities of aldehyde acetal, and croton aldehyde; and they have further discovered, in the

so-called fusel oil, isobutyl alcohol, ethyl alcohol, and propyl alcohol.

Vapour Density of Acetic Acid.— A. Horstmann.—This paper is not suitable for abstraction. It contains a series of algebraic formulæ and tabulated results of the vapour density of the acid referred to from 12·4° to 63·1°.

Solid Bisulphide of Carbon.—Dr. V. Wartha.—Already referred to by us (See Chemical News, vol. xxi., p. 131 ; *American Reprint, May*, 1870, *page* 289).

New Locality where Diamonds have been Discovered.—G. Rose.—The author refers to the diamond found at Dlaschkowitz, a village in Bohemia. The facts are known to our readers from the abstracts from the *Comptes Rendus* for this year.

Cause of the Emission of Light by Phosphorus.—W. Müller.—This very lengthy memoir treats on the question, whether the emission of light by phosphorus is due to its oxidation, or whether it is caused by its volatilisation. A lengthy series of experiments is minutely described ; and the main result arrived at is, that, since phosphorus is not oxidised by oxygen under normal conditions, and its emission of light increased by withdrawal of the pressure of air, it would appear that the luminosity of this substance is in some way connected with its volatilisation.

On Tetraphenol, C_4H_4O.—H. Limpricht.—This substance was obtained by the distillation of an intimate mixture of pyromucate of barium and 0·9 parts of soda lime. Tetraphenol is a colourless liquid, insoluble in water, boiling at 32°, and evaporating so rapidly at ordinary temperature, that a portion of a drop on a glass rod is solidified by the cold produced by the evaporation of the rest.

Use of Hypobromite of Baryta as a Reagent.—W. Knop.—This paper treats on the use of the hypobromite of baryta for the detection of ammonia, but the author's experiments on this subject are not quite complete as yet.

Cosmos, April 9, 1870.

Causes of Steam-Boiler Explosions.—J. Georges.—This author, a mechanical engineer and boiler-maker, states that his experience has taught him that the bursting and exploding of steam-boilers is chiefly due to defects in the iron plates used in the construction of these apparatus; and his proposal is, that, instead of testing boilers under pressure, as is usual, by means of hydraulic appliances, the plates should be tested at the iron-works, and stamped by the *garde-mine*, if found of sufficiently good quality for use for the construction of boilers. (The *garde-mine* is, in France, an official who might be termed, in English, a viewer of mines; but his education, practical as well as theoretical, is far more extensive, and under the Ingénieurs des Mines for each district; the supervision of stationary steam boilers, and of all manufactories connected with mining and metallurgical operations, is also confided to him.)

Laboratory Accident.—A short time ago, the inmates of the Hôtel-Dieu were greatly disturbed by a severe explosion, which shook the large building. On ascertaining the cause, it was found that the chemical laboratory of that establishment was the scene of the disaster ; and among the heap of ruins into which this place was converted was found the almost lifeless body of a young student, who had repaired to the laboratory for making some preparation of oxygen (so the French text reads). As he was severely wounded and quite unconscious, the cause of the explosion has not been ascertained. As a matter of course the whole place was in flames also; but the *pompiers* on duty at the Hôtel de Ville succeeded in quenching the flames in a few minutes, by the aid of the hydrants in the building.

Imperial Agricultural College.—On the 1st of July next will be inaugurated another of these establishments, which have proved highly useful. The College here alluded to will be the first of the kind in the southern parts of France and be established close to the city of Montpellier, where a site of some 25 hectares (about 62 acres) of land has been allotted for the purpose.

April 16, 1870.

Decimal System of Weights and Measures.—We learn that the two Representative Assemblies of the Kingdom of Wurtemberg have unanimously approved of the proposition made by the Ministry, as regards the adoption in that Kingdom of the decimal system of weights and measures, which becomes compulsory also for coinage from the first of January, 1872.

Nature of the Sun.—G. Bernaerts.—The first instalment of a rather lengthy, yet very interesting, paper on this matter, wherein is compiled all recent researches on this subject.

Increase of the Number of Inhabitants of Large Cities and Towns.—Although not belonging to the subjects generally treated in our paper, we may not omit to mention an astonishing fact. Leaving other particulars, we only quote that whereas, in the year 1832, Berlin was, in relation to the number of its inhabitants, the eighth in the order of the European capitals, it is now the third ; its population in 1832 was 250,000, and in 1869 (end of year) it was 800,000, an increase at the rate of 220 per cent. Of all the capitals of Europe, the increase of population of Amsterdam during that time was the smallest, being only at the rate of 12 per cent. The next largest percentical increase to Berlin is that of Liverpool, at the rate of 174 per cent.

Les Mondes, April 7, 1870.

Foundation of a Chair of the History of Medicine and Surgery at the Medical Faculty of Paris.—Since authorisation has been received to accept the legacy of £6000 bequeathed by M. Salmon de Champoreau for the foundation of the chair above named, there will be shortly an election of a properly qualified lecturer for this office.

National Congress for Geographic, Cosmographic, and Commercial Sciences, at Antwerp.—During the month of August next, there will be a meeting at the city alluded to, and among the principal subjects for discussion are:—The astronomical past and future of our globe, its own heat and its cooling down ; is it possible to draw, from the laws which rule these phenomena, conclusions relating to the economy of fuel, and to the influence which the hand of man has brought about by the draining of marsh-grounds and lakes, the cultivation of forest on mountains and plains, the formation of inland seas, &c. ; adoption of the same *first* meridian ; adoption of the same system of measures for use in daily life, as well as for scientific use ; anthropology, in its relation to geography. Among the desirable works to be executed in the interest of all the civilized nations of the world, the congress desires discussion on the piercing of the Isthmus of Panama ; railway towards Persia and India along the Euphrates valley, and conversion of the Desert of Sahara into an inland sea. There will be held at Antwerp, during the meeting, an exhibition of objects relating to geography, ethnography, and commerce.

Black Snow.—M. Feltz.—The author, who resides at Arlovetz, Russia, states that, during a severe gale of wind from the north-east, accompanied by a snow-storm, there fell, on the 31st of January last, between 2 and 4 p.m., a quantity of a blackish coloured substance, strongly contrasting with the peculiar brightness of the previously-fallen snow. On examining this powdery substance more particularly, it was ascertained to be arable soil, which, as was afterwards learnt, had been carried by the violence of the wind for a distance of many miles. The quantity of this soil, dried at 100°, was found to be 6·5 grms. for a surface of a square metre ; and, since it was found that, at the very least,

a surface of 10 square kilometres (3·86 English square miles) had been covered to the same extent with this dust, the quantity thereof carried by the violence of the wind amounted to at least 650,000 kilos. = 650 tons' weight.

Foundation of a Laboratory for Medical Chemistry.—Dr. G. Le Bon.—In imitation of what has been successfully accomplished in Germany, the author has established a laboratory for the special purposes of testing, analysing, and experimenting in physiological and pathological chemistry, in connection with microscopical observations and other requirements of modern medical science.

April 14, 1870.

Cerebral Activity, and the Relation the Composition of Urine bears thereto.—Dr. Byasson.—According to a series of accurately-made experiments, the author having himself been the subject of such trial, he states that cerebral activity is accompanied by a more abundant production of urea, and alkaline phosphates and sulphates; while muscular activity is accompanied by the increased production of urea, uric acid, and chloride of sodium. The author's full researches are recorded in his inaugural thesis, sustained before the medical faculty at Montpellier.

Revue des Cours Scientifiques de la France et de l'Etranger, Nos. 19 and 20, 1870.

Neither of these numbers contain any original papers relating to chemistry; the last-named contains an excellent and full account of a lecture on the—

History and General Properties of Blood.—Claude Bernard.—This lengthy paper treats on this most important subject, commencing from the earliest days of existing written records, and fully entering into physiological as well as chemical details.

Annalen der Chemie und Pharmacie, March, 1870.

This number contains the following original papers and memoirs:—

Chemical Nature of the Xylol contained in Coal-Tar.—R. Fittig.—The gist of this very lengthy paper is that xylol, whether obtained from coal-tar or from other sources, is a mixture of various bodies.

On Isophthalic Acid and some of its Derivatives.—H. E. Storrs and R. Fittig.—The authors describe:—Isophthalic-acid ethyl ether—

$$C_6H_4 \begin{cases} CO(C_2H_5)O \\ CO(C_2H_5)O \end{cases};$$

Nitro-isophthalic acid—

$$C_6H_3(NO_2) \begin{cases} COHO \\ COHO \end{cases};$$

Nitro-isophthalate of calcium and barium; nitro-isophthalic-acid ethyl ether, $C_6H_3(NO_2)O_4.(C_2H_5)_2$; amido-isophthalac-acid—

$$C_6H_3(NH_2) \begin{cases} COHO \\ COHO \end{cases};$$

Hydrochloro-amido-isophthalic acid, $C_6H_5(NH_2)O_4.HCl + H_2O$; sulphuric-amido-isophthalic acid, $[C_6H_5(NH_2)O_4]_2H_2SO_4$.

On Amido-dicyanic Acid.—F. Hallwachs.—This memoir is divided into the following sections:—Preparation of amido-dicyanic acid; amido-dicyanate of silver, $C_2N_3H_2AgO$; amido-dicyanate of copper, $C_2N_3H_2CuO + 2H_2O$; and a series of other salts. The structural formula of amido-cyanic acid is—

$$O=C<\begin{matrix}NH\\NH\end{matrix}>C=NH.$$

On Sulpho-Cyanogen Compounds.—Dr. L. Glutz.—This lengthy essay, is divided into the following parts:—Behaviour of sulpho-cyanide of ethyl with concentrated hydriodic acid; derivatives of sulpho-cyanogen ethylen; rhodan ethylsulphinchloride.

On some of the Derivatives of Oxybenzoic Acid.—Dr. A. K. Heintz.

On Ethyloxybenzoic Acid.—G. Rosenthal.

On Thionessal, Tolallylsulphide, Lepiden, and Oxylepiden.—Dr. J. Dorn.

Synthesis of an Acid Homologous with Cinnamic Acid.—R. Fittig and P. Bieber.

On Molybdic Acid and Compounds thereof.—F. Ullick.—This paper, like all the foregoing of which the titles only are quoted, is an essay and monograph, and far too long for any useful abstraction.

Polytechnisches Journal von Dingler, first number for March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Separator for Water and Steam.—C. von Witzleben.

Improved Evaporator for Saccharine Juices.—M. Schreiber.—Although the contents of these two papers, illustrated by diagrams do not exactly belong to chemistry, the contrivances described are so useful that we translate the titles.

Furnace for the Proper Combustion of Pulverulent and Wet Fuel.—A. Koch.—Illustrated with engravings.

Researches on the Coals of Upper Silesia (Prussia).—Dr. H. Fleck.—This very extensive and exhaustive monograph is a very valuable addition to our knowledge of coals, from a scientific as well as industrial and technical view of this subject.

Alterations Coal undergoes when Exposed to Air.—Dr. E. Richters.—A continuation of the former portion of this author's paper, containing the following sections:—On the causes of the spontaneous combustion of coals; difficultly-combustible coals; readily combustible coals. This paper is to be continued.

Estimation of the Average Size of Starch-Globules.—Dr. Schönn.

Method of Obtaining the Oxalic Acid contained in Madder.—M. Pernod.—When madder is converted into garancine, the oxalate of lime present naturally in madder is decomposed by the sulphuric acid. The oxalic acid thus set free was hitherto lost in the wash-waters; these fluids are now run into suitably-constructed tanks, and saturated with hydrate of lime, which causes the formation of a large quantity of precipitate of oxalate of lime. This salt is collected, and decomposed by sulphuric acid, carefully added, so as just to be sufficient for the combination of that acid with lime. The sulphate of lime is separated by filtration through flannel, and the solution of oxalic acid evaporated in leaden pans, re-crystallized, and fit for the market. The quantity of this acid thus obtained will vary according to the kind and quality of the madder; and it should be observed, also, that the Avignon madder, employed by the author, contains naturally a large quantity of lime—a base which greatly influences the formation of acids in plants in general, and oxalic acid especially.

Second Number for March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Manufacture of Ice for Industrial Purposes.—Dr. R. Schmidt.—A paper chiefly treating on the cost of machinery and ingredients required for the making of ice for breweries and other places where it is required in large quantities.

Action of Sulphuretted Hydrogen upon Manganese Compounds.—A. Wagner.—The contents of this paper relate to a series of experiments made with the view to ascertain whether the hydrated oxide of manganese is preferable to hydrated peroxide of iron for the purpose of the gas-purification process. It appears, from the author's statements, that the iron preparation is in every respect to be preferred for this purpose.

Bleaching of Yarns and Woven Fabrics with the Permanganates of Potassa and Soda.—A. Pubetz.—The contents of this paper are only interesting to bleachers of linen and cotton materials.

Annales des Mines, No. 6, 1869.

This number contains the following original papers and memoirs:—

Mines and Metallurgical Manufactories of the Banat (a Portion of Hungary).—M. Castel.

Additional Notes to a Memoir on the Present State of the Metallurgy of Lead.—L. Grüner.

On some Minerals found in Chili.—M. Domeyko. —*Tungstate of Copper.*—In 100 parts:—Tungstic acid, 56·48; oxide of copper, 30·63; lime, 2·0; oxide of iron, 2·53; silica, 3·87; water driven off at red heat, 4·62. *On the Titaniferous Sand of the Chilian Sea-board, and on the Origin of that Sand.*—The analysis of two varieties of this sand is quoted percentically, care being taken to analyse separately the magnetic and non-magnetic portions. The following quotation will give an idea of the composition of this material as met with at Punta Arenas (on the Straits of Magellan):—Non-magnetic portion—Titanic acid, 19·2; protoxide of iron, 29·7; peroxide of iron, 49·7; lime, 0·9; magnesia, 1·0. Magnetic portion—Titanic acid, 22·8; protoxide, 15·8; peroxide of iron, 61·5.

Mineral Resources of the Ariege.—M. Mussy.—A lengthy monograph of one of the Frontier Departments of France, bound by Spain and the ancient Republic of Andorra.

Journal für Gasbeleuchtung, March, 1870.

Bicarbonate of Ammonia in Illuminating-Gas. —Dr. Rüdorff.—The author states that, during the very severe cold which prevailed at Berlin in the month of February last, a quantity of crystals were found deposited in the purifiers of one of the gas-works at Berlin. The substance exhibits a distinctly-crystalline, well-defined, rhombo-prismatic structure. On analysis, the author found, as the average of three experiments, this compound to correspond with the formula, NH_4HCO_3, containing 21·52 per cent of ammonia. The crystals are interesting, since it has been hitherto found impossible to prepare this bicarbonate artificially.

Regulation for Securing the Use of Gas with Safety and Advice as regards the Arrangements of the Gas-Fittings in Dwelling-Houses, Offices, and Public Buildings for Carlsruhe (the Capital City of Baden).—This paper contains some very useful suggestions for the safe employment of gas in general.

Comptes Rendus des Séances de l'Académie des Sciences, April 18, 1870.

The papers and memoirs relating to chemistry or collateral sciences in this number are:—

Clinorhombic Form of the Red Oxide of Mercury.—M. des Cloizeaux.—The author describes, at great length, the crystallographical shape of this oxide as obtained by a peculiar, but not detailed process, and incidentally mentions, that the *melaconise*, from Cornwall (a native oxide of copper), is, according to Mr. Maskelyne, the only other metallic oxide belonging to the clinorhombic system.

Second Notice relating to the Specific Heat of Water when near its Maximum Specific Gravity —G. A. Hirn.

Experimental Researches on Gold and its Compounds.—J. P. Prat.—The main features of this lengthy paper are the following:—In order to obtain the best possible solution of gold, the two constituents of the aqua regia, nitro-hydrochloric acid, should be each diluted with their own bulk of water previous to being mixed together; the metal having been dissolved, of course heat is to be applied The previously quite cooled liquid is neutralised with bicarbonate of potassa; and, next, oxalic acid is added, which causes the reduction of the gold to the metallic state, but in the shape of a very finely-divided powder, which, however, agglutinates by applying heat, so as to become a spongy mass, which may readily be kneaded into shape by the fingers. The author describes the combinations of gold with oxygen and with chlorine—to wit, an intermediate, or olive-coloured oxide, Au_2O_2; a binoxide, AuO_2; a protochloride, sesquichloride, and perchloride (the latter a volatile substance). Among the salient points resulting from the author's researches, the most remarkable is that gold may be directly oxidised and salified by some of the oxacids, and that, in many instances, gold behaves with reagents as other metals do.

Spectrum Analysis of a Sun's Spot.—G. Rayet.

Variations of the Index of Refraction of Water, as Dependent upon its Temperature.—M. Croullebois.

Assay of Silver which contains Mercury.—H. Debray.—This paper, especially interesting to those who have daily to make assays of silver by the moist way, or Gay Lussac's process, is not well suited for abstraction; and it, moreover, appears that the author is unaware of the fact that, some fifteen years ago, Prof. G. J. Mulder pointed out what is here brought forward as something quite new, in his work (published in the Dutch language) "On the Assay of Silver by the Moist Way." The mercury here alluded to is, of course, a comparatively very small quantity, found in metallic silver occasionally.

Iodhydrates and Chlorhydrates of Monobromated Ethylen and Propylen.—E. Reboul.

New Researches on Black Phosphorus.—M. Blondlot.—The author states that, after having given away all he had of black phosphorus prepared by him in 1866 by Thenard's method, he set to work, some short time ago, to prepare a fresh quantity, but did not succeed until he added some mercury and heated the metal along with it. His researches on the nature of the *pigmentum*, as he calls the black phosphorus, prove that it does not contain even the least trace of mercury; and he concludes that it merely acts catalytically in this instance.

Dextrine Insoluble in Water.—M. Musculus.—It appears, from this lengthy paper, that dextrine may be obtained in a state insoluble in water by acting upon starch with either very strong acetic (glacial) acid; or, also, by modifying the action of sulphuric acid and water upon starch. The dextrine separates in the shape of rather bulky granules, which increase in size (they are, however, very small, because their diameter varies from 0·001 to 0·030 m.m.) according to the length of time they are left in the mother liquor, wherein they are formed; these granules are insoluble in cold water, but are suddenly dissolved when they are placed in water at 50°, and they then remain soluble.

Chloronitric and Bromonitric Ethers of Glycerine.—L. Henry.—The author first observes that the only nitric acid compound, as yet known, of glycerine, is the trinitrine of glycerine, a substance of too great notoriety under the misnomer of nitroglycerine. The author next describes, at very great length, the preparation and properties of—

Monochloro-dinitrine, $(C_3H_5)(NO_3)_2Cl$; monochloro-mononitroglycerine—

$$(C_3H_5)ClO+H(NO_3)=(C_3H_5)Cl(HO)(NO_3);$$

monochloro-dinitroglycerine—

$$(C_3H_5)Cl(HO_3)(NO)+H(NO_3)=(C_3H_5)Cl(NO_3)+H_2O;$$

dichloro-mononitrine, $(C_3H_5)Cl_2(NO_3)$, a colourless liquid, almost insoluble in water, but soluble in alcohol and ether (sp. gr. at 10°, 1·465; monochloro-dinitrine, $(C_3H_5)Cl(NO_3)_2$, also a liquid of great density (viz., 1·5112 at 9°).

Direct Combination of Allylic Compounds with Chloride of Iodine and Hypochlorous Acid.—L. Henry.

Formation of Urea by the Action of Permanganate of Potassa on Albumenoid Substances.—A. Béchamp.—The contents of this valuable paper may be summarised thus:—The elimination of urea in the animal body is the result of the oxidation of the albuminous compounds of the blood; and the author proves this by operating with permanganate upon pure albuminous substances, freed purposely from fatty matters and sugar, and kept in solution by means of a weak alkali.

Aurora Borealis seen on the 5th of April last.—L. Sonrel.—From this lengthy paper, we learn that this phenomenon, already alluded to by us last week, was visible over nearly all Europe, and that, wherever it was visible, the magnetic instruments were violently agitated. The author enters into a great many details on this subject, among which the most remarkable is that the Aurora was accompanied, or preceded, for a brief period, by a very disagreeable smell (the quality thereof is not specified), very perceptible, as well at Dinkelsbühl (Bavaria), as at Paris. In high northern latitudes, this phenomenon is often accompanied by a peculiar, somewhat sulphurous, and rather oppressive, smell.

Poisonous Property of some of the Products of the Phenic Acid Series.—P. Guyot.—The accidents caused by such products as coralline, azuline, &c., depend simply upon the mode of preparation employed; for, if excess of aniline or phenol is present, the material becomes poisonous.

Earthquakes and Volcanic Explosions observed in the Netherlands' Indies from the beginning of the 16th century to the present time.—L. de Backer.—This paper, or, rather, chronological enumeration of volcanic eruptions, earthquakes, and other volcanic phenomena, vomiting of mud and boiling water from a series of volcanoes in the Indian Archipelago, begins with the year 1506, and comes down to our days. No portion of the inhabited globe, during its present geological age, has been the scene of such great and continuous volcanic action as that beautiful portion of the globe here alluded to. This paper is a very valuable contribution to our knowledge of the effects of volcanic action in various ways. The number of earthquakes and eruptions noticed (viz., by Europeans, and recorded by them) from 1506 to 1847 alone amounts to 141; and there is, as observed by Dr. Junghun, very great reason to suppose that this number is 50 per cent too low.

The American Journal of Science and Arts, March, 1870.

This number contains the following original papers relating to chemistry and collateral sciences:—

Photometric Experiments.—Part I.: On a Simple Form of Photometer for Determining the Amount of Light Reflected by Metallic Surfaces at Different Incidences.—Ogden N. Rood.—Illustrated with woodcuts, without which an abstract would not be understood.

Contributions to the Chemistry of Copper.—T. Sterry Hunt.—Reserved for full reproduction.

Silver Mines of Santa Eulalia, State of Chihuahua, Mexico.—James P. Kimball.—A very interesting contribution to the history of silver mining; also bearing testimony to the enormous mineral wealth of Mexico.

Machinery and Processes of the Industrial Arts, and Apparatus of the Exact Sciences.—F. A. P. Barnard.—This is the report made by the author, as U. S. Commissioner to the last Paris Industrial Exhibition, on this subject.

Norite or Labradorite Rock.—T. Sterry Hunt.

Cause of the Colour of the Water of Lake Leman, Geneva, Switzerland.—A. A. Hayes.—The author's concluding words on this often discussed and investigated subject are—"The negative results of chemical analysis, and the sufficiency of the reflected and refracted light of the sky which is over the water of Lake Leman, led me to the conclusion that the cause of the colour is found in the peculiar hue of the sky, so transmitted to the eye by a colourless water."

On the Potassio-Cabaltic Nitrite known as Fisher's Salt, and some Analogous and Related Compounds.—S. P. Sadtler.—This very lengthy treatise is filled with a large number of formulæ. The author's chief conclusion is that the salt alluded to is essentially a compound having the formula $Co_26NO_2+6(KNO)+aq$.

Meteors of November, 1869.—H. A. Newton.

Zeitschrift für Chemie von Beilstein, No. 6, 1870.

This number contains the following original papers:—

On Tetramethyl-Benzol.—P. Jannasch and R. Fittig.—After having entered, at some length, into speculative discussions referring to the possibility of the substitution of more than three atoms of hydrogen in benzol, the authors describe, at great length, the process of preparation whereby they obtained a tetramethyl-benzol, $C_{10}H_{14}=C_6H_2(CH_3)_4$, which substance they have called *durol*, because there may exist several modifications of tetramethyl-benzol. Durol is the only hydrocarbon yet known belonging to the benzol series, which is a solid body at the ordinary temperature of the air. It is crystalline; readily soluble in alcohol, ether, and benzol; fuses about 80°, and boils at between 189° and 191°; is specifically lighter than water; and, when burning, exhibits a very luminous flame. Dinitrodurol, $C_{10}H_{12}(NO_2)_2=C_6(NO_2)_2(CH_3)_4$, is obtained by the action of very strong nitric acid upon durol. Dinitrodurol is also a solid, crystalline body, readily soluble in ether, less readily in benzol and in boiling alcohol, fuses at 205°, and is sublimed without decomposition. Dibromo-durol, $C_{10}H_{12}Br_2=C_6Br_2(CH_3)_4$, a solid substance, very difficultly soluble in alcohol, fusing at 199°, and sublimable without decomposition.

Accton-Sulpho Acid.—Dr. Bender.—The author prepared this substance from dichloraceton and a solution of neutral sulphite of potassa, yielding aceton-sulpho-potassa—

$$C_3H_6SO_4K=CH_3-CO-CH_2-SO_3K.$$

By treating this salt with dilute sulphuric acid, no sulphurous, nor sulphuric acid, is given off; but the aceton-sulpho-acid was not obtained in free state.

Some of the Derivatives of the Toluol Series.—E. Wroblevsky.—This paper might almost be compared to a catalogue. The author enumerates, first, isomeric monochlor-methyl-phenetols, viz.—*a* methylchlor-phenetol, a fluid boiling at about 220° (sp. gr. at 19·5, 1·127); *β* methylchlor-phenetol, also a fluid boiling at 220° (sp. gr., 18°). Secondly, isomeric chlor-iod-toluols, viz.—*a* C_7H_6ClI, a fluid boiling at about 242° (sp. gr. at 17°, 1·716), and is not solidified at −14; *β* C_7H_6ClI, again a fluid boiling at 240° (sp. gr. at 19°, 1·770). Thirdly — Paraiod-orthobrom-toluol, C_7H_6BrI; dichlortoluidine, $C_6H_3Cl_2.CH_3$; nitro-dichlortoluol, a fluid exhibiting the smell of nitrobenzol, soluble in alcohol and ether, and boiling at 274° (sp. gr. at 17°, 1·455).

Isomeric Nitro-Bromotoluols and Bromotoluidine.—E. Wroblevsky.—This paper is chiefly a critical review of the labours of a great many chemists who have been engaged in researches on this subject, and, like the foregoing paper, is a catalogue of substances.

On Diethglyoxylic Ether.—A. Schreiber.—Of the substance here alluded to, the preparation and derivation are described at great length. Diethglyoxylic ether, $CH(C_2H_5O)_2COOC_2H_5$, is a very clear, colourless, strongly-refrangible liquid (sp. gr. at 18°, 0·994), miscible with alcohol and ether in every proportion; diethglyoxylic acid amide, $CH(C_2H_5O)_2CONH_2$, is a solid substance crystalline, fusing at 76·5, and readily soluble in water and alcohol.

Conditions of the Formation of the Mono-Sulpho Acids of Naphthaline.—V. Merz and W. Weith.—This paper is not well suited for useful abstraction.

Revue Hebdomadaire de Chimie, April 7, 1870.

Preservation of Beet-Root Leaves for Fodder for Cattle.—M. Mehay.—Under this title, the author describes, at great length, a method of preservation of the leaves alluded to, but also applicable to other leaves of a similar nature, and perhaps to grass, which method consists mainly in the following process:—Into a vessel of some 2 hectolitres' capacity (about 45 gallons) are poured from 2 to 3 decilitres (each decilitre is equal to 0·176 pint, or 6·102 cubic inches) of hydrochloric acid, sp. gr. 1 18 (that is to say, an acid of 38 per cent of ClH at 15·5°); and next there is added to this acid a large quantity (how much is not stated) of water. The fluid is thoroughly mixed, by means of a wooden spatula; and next, 50 kilos. of the leaves, yet attached to the crown part of the root, which is cut off, are placed in this liquid and thoroughly immersed therein. This having been done, the entire mass is heated to the boiling-point, and kept boiling for 10 or 15 minutes; the leaves are taken from the cauldron, by means of wooden forks, and placed on hurdles, so as to admit of the surplus liquid draining off, after which the leaves are fit to be preserved in a manner similar to that in which potatoes, turnips, and the like are kept, by being placed in pits covered inside with straw, and next covered over with the soil of the garden or farm ground. We cannot enter more fully into this subject, which is, however, deserving the attention of agriculturists. The author states that the acid combines with the alkaline salts of the leaves and thus forms chlorides of sodium and potassium; the quantity of acid is too small, moreover, to affect the health of the cattle. It is clear that either iron enamelled cauldrons, or those made of copper, can only be used with open fire; where steam is at hand, well made wooden tanks may serve.

A New Manure.—M. Auvillain.—The author treats residues and offal of fish, first boiling the same, with addition of 1-10th of the weight of the mass of any cheap oil, heating up to from 120° to 140°. By this means, all the water is expelled from the offal, which is next treated with sulphide of carbon, whereby the oil naturally contained in the fish, as well as that which was added, is extracted, leaving a mass quite dry, and containing from 5 to 6 per cent of nitrogen and from 12 to 15 per cent of phosphate of lime.

Production of Petroleum (Paraffin Oils) in the United States.—L. Péaud.—It appears that the quantity produced of the substance alluded to is largely on the increase, since the average daily production amounted, in 1868, to 10,863 barrels, and in 1869, to 13,197 barrels. The stock on the first day of this year was, in the States and Canada jointly, 1,238,000 barrels.

Berichte der Deutschen Chemischen Gesellschaft zu Berlin, No. 3, 1870.

This number contains the following original papers:—

Preparation of Ethylamines on the Large Scale.—Dr. A. W. Hofmann.—This lengthy paper treats on the preparation of ethylamines, by applying thereto the by-products obtained during the manufacture of hydrate of chloral. This material is treated in closed vessels, at 100°, with a concentrated alcoholic solution of ammonia.

Synthesis of Aromatic Acids.—V. Meyer.—This paper is subdivided into the following groups:—Synthesis of benzoic acid; synthesis of isophthalic acid; constitution of substituted benzoic acid.

Contribution to our Knowledge of the Constitution of Camphor.—V. Meyér.—This very lengthy paper, full of complicated formulæ, is not well suited for abstraction. In a foot-note, the author observes that most of the recently published works on organic chemistry quote the melting-point of camphoric acid at 62·5, whereas some six years ago, the researches of MM. Tollens and Fittig proved the melting-point of that acid to be at about 176°; and the author's researches have confirmed this particular.

Crystallized Hydrate of Soda.—O. Hermes.—The author states that, during the cold weather which prevailed at Berlin some two months ago, he had the opportunity of obtaining, from an aqueous solution of caustic soda (sp. gr., 1·365), beautiful crystals of rhombo-prismatic shape, perfectly transparent, fusing at 6°, and containing 30·09 *NaO*. The formula of this compound is, therefore, *NaO+8HO;* or, according to more recent views, $2NaOH+7H_2O$.

Contribution to our Knowledge of the Iodides.—E. Meusel.—The author describes iodide of copper, which he obtained by the slow action of metallic copper from hydriodic acid, in the shape of faintly greenish yellow-coloured tetrahedrical crystals, which become dark-coloured by exposure to light. The author next describes some experiments relating to the action of light on the chlorides, fluorides, iodides, and bromides; and, lastly, gives a review of the various analytical methods in use for the quantitative analysis of insoluble iodides. The author's method is based upon the solubility of the iodides of mercury, lead, silver, and copper in hyposulphite of soda; the metals are precipitated from that solution by hydrosulphuret of ammonium, and all the iodine remains in solution. After removal of the sulphurets of the metals, ammonia is added to the filtrate, and the liquid evaporated, so as to expel the bulk of the sulphur in the shape of sulphide of ammonium. Solution of caustic soda is next added; and, after evaporation to dryness, the saline mass is ignited, next dissolved in a small quantity of water, solution of chloride of iron is added in excess, and the iodine, after having been taken up by iodide of potassium, is estimated by titration.

On those Haloid Compounds which Correspond to Picric Acid and Dinitro-Phenol, and on some Derivatives thereof.—C. Clemm.—Under the above title, this very lengthy paper treats on chloro-nitro-benzol, chloro-dinitro-benzol, bromo-dinitro-benzol, and on nitro-derivatives of the haloid compounds here named.

On so-called Chloraceten.—A. Kekulé and Th. Zincke.—After referring, at some length, to the researches of various scientific chemists who have been occupied with this subject, the authors, in their lengthy monograph, give a series of experiments, and come to the conclusion that chloraceten is simply a mixture of aldehyde and paraldehyde, containing hydrochloric acid or chlorocarbonic gas.

Condensation of Aldehydes.—A. Kekulé.—Not suited for any useful abstraction.

Products of the Oxidation of Paraffin.—E. Willigk. This paper, a preliminary notice, contains the description of a series of experiments, whereby pure paraffin, treated at a high temperature with a mixture of nitric and sulphuric acids, is made to yield materials which belong to the series of fatty acids. The author's researches on this subject are not, however, quite complete.

No. 4.

Contains—

Products of Distillation of Coal-Tar which Boil at a High Temperature.—C. Graebe and C. Liebermann.—The authors state that they obtained, from a tar distillery at which the distillation is pushed till a coke only remains, a

solid, lemon-yellow coloured, fatty-looking material, fusing at 150°, while its boiling-point is higher than that of mercury. This material was soon recognised by the authors to be a mixture of various substances, but chiefly made up of chrysen, which, after having been purified, was found to fuse at from 245°—248°, and difficultly soluble in alcohol, ether, and sulphide of carbon, a little more readily soluble in boiling anhydrous acetic acid and in benzol. The authors have studied, also, some of the products of oxidation of chrysen, and among these a body called chrysochinon, $C_{18}H_{10}O_2$. The formula of chrysen is $C_{18}H_{12}$.

Betaine and its Constitution.—C. Schiebler.—This lengthy paper is illustrated by diagrams, and, therefore, like the following—

Identity of Oxyneurine and Betaine—Dr. O. Liebreich—Not suited for abstraction.

Chlorophosphide of Nitrogen.—H. Wichelhaus.—This paper contains a review of the labours of various authors on this subject.

Description of an Improved Shape and Arrangement of Hofmann's Apparatus for the Determination of Vapour Densities.—H. Wichelhaus.—This paper is illustrated by a woodcut, essentially required to the proper understanding of the contents.

Our Present Knowledge of the Mineralogico-Chemical Properties of Meteorites.—C. Rammelsberg.—A lengthy essay, chiefly of mineralogical interest.

Contribution to the History of the Platinum Bases.—Charles Gordon.—A review of the labours of Reiset, Magnus, Raewsky, and others on this subject.

On Paytine.—O. Hesse.—Under this name, derived from the seaport of Payta (Peru), the author describes a new alkaloid, found by him in the cinchona bark shipped from the place alluded to. Paytine, $C_{21}H_{24}N_2O+H_2O$, is readily soluble in ether, benzol, chloroform, and alcohol, but very difficultly soluble in water; fuses at 156°; exhibits an alkaline reaction to test-paper, but does not very readily form salts, nor is it quite neutralised with acids. On being heated with soda-lime, paytine yields a substance, paiton, free from nitrogen.

New Organic Phosphorus Compound.—L. Darmstädter and A. Henniger.—The author describes a material accidentally discovered by him, and found to be cyan-ethyl-phosphide, C_3H_6NP. In 100 parts—C, 41·37; H, 6·90; N, 16·09. Since the quantity obtained was very small, no other experiments could be made with this substance.

NOTES AND QUERIES.

Glycerine.—It will be a favor if you can inform me of a good test, or tests, to ascertain the commercial value of glycerine, and that it has not been adulterated with glucose or other matter.—Subscriber.

Volatilising Common Salt.—Would any of your readers kindly inform me of the best means of volatilising common salt? Must superheated steam be driven through it, or will an extreme heat be all that is necessary?—Enquirer.

Dinitrobenzol.—I shall be glad if any of your correspondents can tell me of a better process for making this substance than those given in "Watts" and "Miller." I have tried them and have not succeeded in making it.—W. H. W.

Liq. Ammoniæ.—(Reply to J. Spencer.)—You can find the description of the apparatus you want in the work on Technology, published by M. Bailliere, and edited by Dr. Richardson and Mr. Watts. The work may be inspected at the Library of the Commissioners of Patents. Our space is too limited to describe the apparatus here.

Dr. Schiebler's Apparatus.—(Reply to W. R.)—When the earlier portion of my notes were prepared the fifth edition of "Fresenius" was not published—the publication being almost simultaneous with the appearance of my first paper. For general description of apparatus consult "Fresenius" (4th edition, p. 711). The apparatus I work with was purchased in Berlin, but is, I think, supplied by Dr. Schiebler, Dettin, for 20 Thalers (about £3), complete. It is applicable for all carbonates where carbonic dioxide is the only gas evolved.—W. Arnot.

Alumina.—(Reply to Arthur Warner.)—Wavellite is not, as you suppose, a native alumina, but the native phosphate of that base. Whether or not any pure native hydrate of alumina occurs in Cornwall, we are not now prepared to say. Under the name of bauxite, a native hydrate of alumina of great purity occurs in the south of France. Kaolin, after thorough calcination, may be made to yield, by treating it with boiling sulphuric acid (sp. gr., 1·384), very pure sulphate of alumina (alum cake); and kaolin is abundantly found in Cornwall. On perusal of our advertising columns, you will find that pure alumina is advertised for sale.

Removing Silica.—(Reply to W. H.)—The silica is present in the carbonate of potassa chiefly as a silicate; and it is stated in the *Handwörterbuch der reinen und angewandten Chemie* that digestion of this salt with pulverised charcoal will decompose the silicate. Your best plan, however, is, since it appears that you have to deal with a very crude material, to dissolve it in three-fourths of its weight of cold water, and, after decantation of the solution, leave the residue exposed to air, the carbonic acid of which slowly decomposes the silicate. The aqueous solution obtained should be evaporated to dryness, when it will yield a pretty pure carbonate of potassa.

To Purify Methylated Spirit.—(Reply to "Bichromate.")—Arrange an apparatus as for the continuous distillation of ether, but let the proportion of sulphuric acid be less than is necessary for etherification. Probably there is but little destruction of methyl, but the effect is very materially to sweeten the filthy compound. The distillate is acid, and must be drawn over again, after digestion with carb. of potassa.—R. T. Clarke.

Dissolving Cellulose.—(Reply to "Bichromate.")—It appears, from the researches of M. Persoz, jun., that the easiest plan for preparing a very active ammonio-cupric solution is to cause strong liquid ammonia to act upon a piece of copper with contact of air, briefly to stir strong liquid ammonia with a piece of copper, until the fluid, of which, now and then, a small sample may be taken for testing, dissolves cotton readily in the cold; wool is insoluble in this fluid in the cold, but is readily dissolved when heat is applied. Chloride of zinc solution of a sp. gr. of 1·718 dissolves silk slowly in the cold, rapidly by application of heat (see, on this subject, J. Persoz's paper in the *Comptes Rendus*, vol. lv., p. 810 (1862), which you can peruse at the Patent Office Library). As to a cheap method of destroying the smell of methylated spirits, you might try re-distillation, after having left the fluid in contact for some time with some quick-lime and well-burned charcoal.

Hardness of Water, &c.—I shall be favored by an explanation of this anomaly in testing the hardness of water by Clark's standard. Supposing a water requires 32 soap tests to produce a permanent lather for five minutes; such would be called of 16° hardness. Take another water, requiring, say, 34 soap-tests, the hardness of which would be, by the scale, 15 and 4-10ths degrees. Thus—2-34ths degrees=17 and 17 soap-tests=7 and 7-10ths degrees, which, multiplied by 2,=15 and 4-10ths degrees, being actually less than a water requiring but 32 soap-tests, whereas we know that such water would really be harder than the first example! And, query, is the native sulphate, selenite, or the artificial chloride of calcium, preferable as a standard solution?—W. R.

Baumé's Hydrometer.—(Reply to J. T. E.)—You cannot certainly use this hydrometer (better, areometer) for determining the specific gravity of glass. If you want to know that, you could use Nicholson's hydrometer, with weights, which is an instrument made of brass, and sold by instrument makers; or you may determine the sp. gr. of the glass by the well-known methods described in books on natural philosophy. The specific gravity of the glass the hydrometers are made of, whether graduated according to Twaddle's, Baumé's, Beck's, or any other scale, has nothing to do with the instrument as constructed for use; but very frequently the instruments sold are not very well constructed, and mutually differ as to their indications, even at the same temperature. The average sp. gr. of glass varies, according to its composition, from 2·64 to 3·77.—Nemo.

Caustic Soda and Lime.—Perhaps some of your readers will explain the following, as I do not find anything relating to it in any work I have at hand:—Having occasion to use caustic soda in considerable quantities, and finding that unless sufficient lime has been used to decompose the whole of the carbonate of soda, it does not answer my purpose, and wishing to have some means of ascertaining this readily, I thought lime-water might answer on the supposition that if the soda solution contained carbonate of soda the lime would be precipitated as carbonate of lime. I tried several samples with it, each of which produced a white precipitate. I then tried the purest caustic soda I could get at in Manchester, with the same result. I afterwards diluted a sample of commercial caustic soda to sp. gr. 1075, and added lime-water so long as any precipitate was formed, then filtered it, and concentrated the clear liquor quickly to about 1070 sp. gr.; on again adding lime-water to this, the lime was precipitated as before. What I wish to know is whether I am right in inferring that in each case the precipitate was caused by the presence of carbonic acid, and taking that for granted, how is it (as in the instance given) that the solution which would not give any further precipitate should, on concentration, again have that property. Would it be owing to carbonic acid absorbed from the atmosphere?—Enquirer.

Glycerine.—"Subscriber" is referred to pages 71 and 167 of our 19th volume (*Am. Repr., April, '69, page 213, and June, '69, page 334*).

Volatilising Common Salt.—(Reply to "Enquirer.")—Common Salt is readily volatilised in the presence of aqueous vapours, and is by no means a non-volatile substance, even at temperatures short of red heat.

Barwood Red and Indigo Blue.—Perhaps some of your numerous correspondents would favour me with the best modes of producing the above on cotton cloth, both as regards brilliancy of colour and economical production.—Chemicus.

Dr. Schiebler's Apparatus.—If W. R. will refer to the new edition of Fresenius's "Quantitative Analysis," under "Carbonic Acid Estima-

[English Edition, Vol. XXI., No. 544, page 203; No. 540, page 156; No. 541, page 168.]

tion," he will find a description and figure occupying three pages.—A. V.

Detection of Linseed Oil in Rape Oil.—(Reply to B. Ludlow.)—See Chemical News, vol xix., pp. 238 and 252 (*Am. Repr., July*, '69, *pp. 32 and 51*). There does not exist, as far as we have been able to ascertain, a special work on oils, either in the English or any other language.

Native Crystalline Phosphates.—Apatite occurs, in the crystalline state in various forms, and so do other phosphates; and therefore the statement made by Mr. Hutton, in reference to the Canadian phosphate, should be taken in less a decided and exclusive manner. Any work on mineralogy will prove the existence of a variety of native crystalline phosphates.—T. A.

Dinitrobenzol.—(Reply to W. H. W.)—There is no doubt that the methods for preparing this compound as described by Dr. Miller and Dr. Watts, are as good as any; if you desire others, you should peruse such periodicals as the *Bulletin de la Société Chimique de Paris*, the *Annalen der Chemie und Pharmacie*, and the *Zeitschrift für Chemie von Beilstein*, all of which you may inspect at the Library of the Commissioners of Patents.

Hardness of Water.—(Reply to W. R.)—A water of 15 and 4-10ths degrees would require 31 measures of soap, but if diluted to twice its volume, it would require 34 measures of soap. Take another instance: the standard water, if diluted to twice its volume, would require 35 measures of soap. The extra quantity of soap used, after diluting, represents the hardness of the pure water added. Selenite is preferable to calcium chloride for the standard water, as it requires no preparation; when finely powdered, it readily dissolves. A useful table will be found in the new edition of Fresenius's "Quantitative Analysis," which is an expansion of Clark's, and saves all trouble of calculation; it gives the soap-test required from 0° to 16°, at intervals of 1-10th degree.

Barwood-Red and Indigo-Blue.—(Reply to "Chemicus.")—You may consult "Die Färberei der Gespinnste und Gewerbe von Reimann" (p. 28 and following, and 210 and following), where you will find a great many practical receipts.

Chlorate of Soda.—I cannot succeed in making chlorate of soda satisfactorily by means of tartrate of soda and chlorate of potash. Large proportions of the two salts remain undecomposed, and I found a sample of commercial soda chlorate nearly as bad as my own. —W. H.

Sulphate of Ammonia.—Would you kindly tell me what proportions of sulphate of ammonia, lime, and water (say to 1 cwt. of sulphate) are used in practice for making liquor ammonia. I have no work that gives any particulars worth naming—Watts's "Chemistry" is rather too expensive.—A Working Man.

Colouration of Glass.—I was to-day shown a piece of glass which lately formed a part of the Land's End light-house, the lamp of which was broken by a heavy sea some time back. This glass exhibited a rather striking peculiarity, the explanation of which I seek from the courtesy of your readers. The piece in question was about 3 inches long by 2 inches broad, and ⅛ an inch thick, and was of a beautiful amethystine colour where, probably, acted upon by the light; but at the edge, where protected by putty or other sheltering material, the glass had entirely retained its white transparent hue. Not only was the surface affected in this manner, but the colouration apparently extended completely through the glass.—Ria.

[Such colouration, under the influence of light, is not uncommon when the glass contains manganese.—Ed. C. N.]

Detection of Strychnia in Organic Matter.—Can any of your readers inform me where I can find a description of Stas's process for the detection of strychnia in organic matter.—Alpha.

Chlorate of Soda.—"W. H." is referred to Brande's "Manual of Chemistry, vol. i., pp. 563, 609. This work may be inspected at the Library of the Commissioners of Patents.

Wood-paper.—I observe in an advertisement in the Chemical News that Dr. Moffat mentions wood-paper in a list of his investigations. Being anxious for information on the subject of wood-paper, I should feel greatly obliged if the learned Doctor would kindly let me know where his investigations are published. Has any other celebrated chemist devoted attention to the subject?—A. B. C.

Sulphate of Ammonia.—(Reply to "A Working Man.")—When chloride of ammonium is used for the purpose you allude to, 5 parts of that salt, previously powdered, are mixed with 4 parts of slack lime, and the mixture is moistened so as to form lumps when squeezed in the hands. With sulphate of ammonia you should take equal parts by weight of both lime and the sulphate (a slight excess of the former is preferable), and water as just stated. Sulphate of ammonia only yields 23 per cent of ammonia gas, whereas sal ammoniac yields 32 per cent.

Latent and Sensible Heat.—It is a well-known fact that copper and spelter when brought together, as they are in making brass and yellow metal, generate a large amount of heat in excess of that which they had separately or collectively possessed before. Now I would feel it a great kindness if you would inform me what this excess of heat amounts to, and how it is accounted for. Suppose, for example, 60 lbs. of copper at its point of liquefaction, or 1996° F., and 40 lbs. of spelter at say 720°, or its point of liquefaction, were put together, what would be the degree of heat or the temperature of the compound?—Compound.

Continuous Current of Air.—In your last number I am reported to have told the Chemical Section of the Glasgow Philosophical Society in my paper on "A Method for Obtaining a Continuous Current of Air, &c.," that, from calculations made, I had no doubt that, with a Herapath lamp, I could get a blast quite as strong as that obtained by using the Griffin lamp. As nearly as I can remember, what I *did say* was that "I was not possessed of a Griffin lamp. But I did not think the blast of air obtained by this apparatus would be sufficiently strong to consume the gas delivered by one; because with a Herapath lamp, the blast of air obtained was just sufficient to maintain a blue flame when the gas stopcock was full open, and the pressure in the main not greater than 27 mm., or so." By giving this correction a place in your next issue you will greatly oblige.—T. L. Patterson, Greenock, April 18th, 1870.

Detection of Strychnia.—(Reply to "Alpha.")—Stas's method will be found in Fresenius's "Qualitative Analysis," p. 243.—A. V.

Drop Black.—I would like to know the method of preparing the substance sold under the names of drop black and imperial drop black. I cannot find any information in books regarding it.—P. H.

Ozone.—Upon examining the contents of some bottles in which N had been prepared by the slow oxidation of iron filings, I found abundant evidence of ozone, both by smell and by the ordinary starch test. —T. B.

Latent and Sensible Heat.—(Reply to "Compound.")—It would be very difficult, if not altogether impossible, to estimate the amount of heat you allude to; but the cause of it is that a chemical combination takes place, attended by the phenomena you allude to; and that this explanation holds good has been proved by Dr. J. H. Croockewit, who, some twenty years ago, made a series of experiments, on a sufficiently large scale, on the metallic alloys. His researches have been published as a separate Dutch work; but, as far as our recollection goes, the author was not able to estimate the amount of heat set free during the sudden combination of the metals you allude to. The cause of this failure is the obvious fact of the want of proper means of estimating high temperatures with sufficient accuracy.

Pyro-Electric Gilding.—In your issue of the 14th inst. (*Am. Repr., June*, '70, page 357), I see a quotation from the *Bulletin de la Société d'Encouragement pour l'Industrie Nationale* (No. 206, February, 1870), to this effect:—"*Pyro-Electric Gilding Invented by M. Masselotte, to whom a prize of £20 has been given.*—M. Barral.—From the author's report, it appears that this invention is very valuable, since it possesses all the advantages of the best method of mercurial gilding, without being at all detrimental to the workmen." I have been practising this system of gilding and silvering now for over five years under this very title, and was the first to invent the process and used the title. In 1865, I patented this method in France; and in 1868 I patented an improvement on this method in France. M. Masselotte may not have seen my specification, but using the exact title looks suspicious.—J. Baynes Thompson, Electro-Metallurgist, Pyro-Plater, &c.

[By referring to the original report, of which we gave an abstract, Mr. Thompson could at once see if the two processes are similar.—Ed. C. N.]

Sulphur in Coal-Gas.—The following note of the formation and condensation of sulphuric acid by the combustion of sulphur compounds in coal-gas in a common fish-tail burner shaded by an ordinary ground-glass globe may, perhaps, interest some of your readers:—Having occasion to take down a gas globe, I noticed a number of brown drops of liquid scattered over its internal surface; on collecting and testing them, they were found to consist of pretty concentrated sulphuric acid, the comparatively high degree of concentration being due to the great temperature acquired by the globe, the heat being far greater than the hand could bear. The brown colour was, doubtless, produced by the carbonisation of organic dust. Also two or three strips of copper, placed over the mouth of the globe to support a shade, were found to be coated with anhydrous cupric sulphate. From the short time which had been taken in the production of the acid (a fortnight, the gas burning for about three hours of an evening, at the rate of 5 ft. an hour), I should think the gas was rather too rich in sulphur to be an unmitigated good to the consumer.—Archid. Liversidge.

ANSWERS TO CORRESPONDENTS.

NOTICE.—The American Publishers of The Chemical News *give notice that, in accordance with a suggestion of* Mr. Crookes, *the Editor and Proprietor of the English Publication, they will be pleased to receive and forward to him in London any scientific publications issued in America, for review—and also any Notes and Queries, Articles, Correspondence, etc., for publication or reply. Their facilities of communication with* Mr. Crookes *render this very desirable to all persons in the United States who wish to confer with him. Address to him, care of*

W. A. TOWNSEND & ADAMS,
434 Broome Street, New York.

W. R.—Your first letter was in type when your second letter arrived.

Alcohol.—Full directions for the preparation of hydrate of chloral have already appeared in our columns.

J. C. M.—You had better advertise.

W. Arnot.—Received. Many thanks for the trouble you have taken in the matter.

R. W.—Our advertisement-sheet is the proper medium for making your wants known. We can only insert replies to queries which are likely to be useful to our general readers.

A Reader, Redditch.—Consult "Cooley's Cyclopædia of Practical Receipts," published by Churchill.

Chemicus.— It will not be published before the autumn.

P. Holland (Manchester).—Any work on Chemical Analysis will give you the information you require.

Bichrome.—The lead pump has not made the water hard; it has probably become so from natural causes.

James Bebbington.—Metallic cobalt is not found native, neither is it met with in commerce except as a scientific curiosity.

AMERICAN SUPPLEMENT.

New York, June, 1870.

Historical Notes on the Defunct Elements.

BY H. CARRINGTON BOLTON, PH.D.

(Read before the New York Lyceum of Natural History, May 9, 1870.)

Earth, air, fire, and water, the four elements of Aristotle's age, and mercury, salt, and sulphur of the visionary alchemists, can hardly be included in the term "Defunct Elements;" the history of the latter properly beginning at a later period, simultaneous with the rise of modern chemical science.

Almost as soon as the term element was employed in its present signification, and the discovery of new elements was chronicled, chemists began to accumulate material for a catalogue of defunct elements. The latter half of the eighteenth century witnessed the discovery of sixteen *bonâ fide* elements; it was during this period of great chemical activity that the defunct elements originated.

A complete catalogue of these elements is nowhere found; startling announcements of their birth, and modest notices of their death, are scattered throughout periodical literature. This has greatly increased the labor of collecting them, but it is believed that the following list is comparatively full:—

TERRA NOBILIS.

Taking them up in chronological order, the first (claiming only passing notice) is Terra nobilis, discovered in 1777 by Torbern Bergmann. Bergmann based his discovery on the fact that the silex of which diamonds were supposed to be composed, yielded peculiar reactions before the blowpipe, quite different from the silex of other minerals; accordingly he called the earth *Terra nobilis*, or *Edelerde*. His theory was short-lived, though the true composition of diamonds was not established until the year 1814, by Sir H. Davy.

HYDROSIDERUM.

In 1780, Meyer, an apothecary of Stettin, observed that upon treating crude iron with strong acids he always obtained a residue and not understanding the reactions of the black powder, he pronounced it a new metal. At first it was called Hydrosiderum, "Wassereisen," but Bergmann, who confirmed his statements, shortened the name to Siderum. Meyer made a careful and laborious examination of this substance, the account of his researches filling more than thirty duodecimo pages, but he failed to establish its identity.

Klaproth and Scheele soon after showed that Hydrosiderum was nothing more than a compound of iron with phosphorus.

AUSTRALIUM.

Josiah Wedgewood, better known by the ware and the pyrometer called by his name than from chemical researches, analyzed, in 1790, sand from Sydney, New South Wales. From this he obtained an earth possessing the peculiarity of being soluble in strong hydrochloric acid and precipitated by water, and he called it Australia, or Sydneia. Klaproth expressed doubts as to the accuracy of Wedgewood's experiments; and Hatchett, in 1798, after careful analysis, pronounced Australia nothing but a mixture of alumina, iron oxide, silica, and graphite.

AGUSTUM.

Agustum, or rather "Agusterde," for so the oxide was called, was discovered in 1800, by J. B. Trommsdorff, Professor of Chemistry in the University of Erfurt. The peculiar earth was extracted from the mineral then known as "Sächsische-beryll." Trommsdorff named it *A-gust-erde*, from its forming tasteless salts. Some of the material he sent to his friend Richter, who was engaged in examining it when he learned that the French chemist Vauquelin had ascertained it to be phosphate of lime. In fact, "Sächsische-beryll" is now known as *Apatite*.

Richter afterwards succeeded in making a mixture of carbonate and phosphate of lime, exhibiting behavior with reagents identical to that of Agusterde; he also pointed out that Trommsdorff had relied too exclusively on stoichiometrical results, and had neglected the necessary qualitative examination.

SILENIUM, OR "SILENE,"

Was discovered in 1803, by Proust, Professor of Chemistry at Madrid. It proved, however, to be Uranium, which was of comparatively recent discovery.

NICCOLANUM

Was discovered in 1805, by Richter, in Saalfelder cobalt ores. The metal very closely resembled nickel, but was distinguished from it by its color, which was nearer that of iron, by being ductile only when cold, and not reducible by heat; while it was distinguished from cobalt by its forming green solutions, which turned red on evaporation. Richter classed it among the noble metals. Two years later we find him sceptical as to its existence, and in 1808, Hisinger and Berzelius, having obtained some of his material, settled the question by showing it to consist of nickel, containing about six per cent. of cobalt, with some iron and a little arsenic.

ANDRONIA.

J. J. Winterl was Professor of Medicine, Chemistry, and Botany at the University of Pesth. Not possessing any skill as a manipulator, he turned his attention to theoretical chemistry, and published about the beginning of this century a pamphlet entitled "*Prolusiones ad chemiam sæculi deciminovi*," in which he set forth his peculiar views; this essay, and another issued shortly after ("*Accessiones novæ ad prolusionem*," etc.), contain the most extraordinary creations of fancy, unworthy of the enlightened period in which he lived, and pronounced by contemporaneous chemists a return to the alchemistic age. Winterl finds the antiphlogistic theory, as established by Lavoisier and his compeers, altogether unsatisfactory, and he evidently intends to completely overwhelm it with his own brilliant ideas. This is not the place, however, to discuss what is known as the dualistic theory,* though it excited great controversy, as the numerous essays in the journals of that day abundantly testify.

The absurdity of Winterl's speculations was only equalled by the inaccuracy of his experiments; his reasoning with reference to Andronia will amply suffice for example.

He states that "in all nature we find a substance having these properties: *first*, acidity; *second*, non-volatility; *third*, yielding with a little oxygen, nitrogen; with more oxygen, carbonic acid; and much of both, nitric

* Winterl's System d. dualist. Chemie dargest., von J. Schuster. Berlin, 1807.

acid!" Combined with hydrogen it forms the material of which the greater part of organic matter is composed; "consequently," he argues, "it is to be found in charcoal," and he claims to prepare it by igniting charcoal with saltpetre and exhausting the residue with water. The material thus obtained and possessing the above-mentioned remarkable properties he called Andronia. It seems strange that any one, even at that early day, could be found to credit such absurdities, but we find that Oersted condescended to repeat the experiment just named *nine* times, "obtaining," he gravely says, "a little silica." Bucholz also denied Winterl's statements, and many chemists opposed his theories. Winterl replied to their objections with new proofs (?), and finally sent a specimen of his precious Andronia to the French Academy of Sciences, where a committee of such distinguished philosophers as Berthollet, Fourcroy, and Vauquelin were appointed to examine it.

It is scarcely necessary to add that they found it to consist of a mixture of lime, alumina, iron oxide, and silica, which constituents, they remark, probably came from the *earthen crucibles* in which Winterl's experiments were conducted.

Thelike, another equally remarkable element, which Winterl discovered at the same time, only requires mention for sake of completeness.

NITRICUM, ARÆON AND MURIUM.

Equally worthy of credence stand the hypothetical elements here named. *Nitricum* is the name proposed by Berzelius for the imaginary body which, united with oxygen, forms nitrogen. *Arœon*, according to Meissner, is *ponderable caloric*, elements being compounds of Arœon with unknown radicals; thus hydrochloric acid is formed of two equivalents of oxygen, one of water, combined with Arœon and the radical *Murium*.

JUNONIUM

Was discovered by Prof. Thomson, of Edinburgh, in 1811, in the mineral Allanite; its identity with Cerium was shortly proved by Wollaston.

THORIUM.

In 1815 Berzelius announced the discovery of a new earth in Fluocerite and Gadolinite, which he called Thoria, but he afterwards found it to consist of phosphate of yttria, and for a few years Thorium was accounted a defunct element. Having the good fortune to discover, in 1828, a new earth much resembling the old Thoria, he revived the name, and thereby erased his own name from the class of discoverers of whom we write.

VESTIUM.

The year 1818 was rendered memorable by the discovery of two defunct elements, Vestium and Wodanium. The same volume of, Gilbert's Annalen which announces the discovery of Cadmium by Hermann and Stromeyer, contains an account of Vestium. This metal was discovered by Von Vest, Professor at Gratz, in nickel ore from Steyermark; Von Vest first called it Sirium, but Gilbert proposed the name of Vestium, from the planet Vesta; "reminding one also," he naïvely adds, "of the eminent discoverer." Gilbert urges in this connection Klaproth's example in deriving the names of elements from the heavenly bodies, and as Berzelius and Wollaston have already supplied us with cerium and palladium, Gilbert suggests the propriety of completing the list by calling Stromeyer's metal "Junonium" and Von Vest's, "Vestium." The interest which Gilbert took in christening these elements was all in vain; Junonium is to-day known as Cadmium, while Vestium is utterly forgotten.

Faraday, at that time assistant to Davy, found conclusively that Vestium was a mixture of nickel, iron, sulphur, and arsenic.

WODANIUM

Was discovered in nickel ore by Lampadius, Professor at the Freiberg School of Mines; the name is derived from *Woden*, the same Scandinavian deity who has bequeathed us his name in the more familiar term Wednesday. Lampadius describes the metal as of a light bronze color, malleable, and magnetic, forming colorless solutions which yield a white precipitate with carbonates and a light blue with ammonia; and to render its precise nature as definite as possible, concludes by saying that "Wodanium bears the same relation to nickel that tellurium does to antimony." In 1820 Stromeyer analyzed the mineral called Wodankies, and found it to consist of about 16% nickel, 4% cobalt, 11% iron, 56% arsenic, and 10% sulphur, but no trace of Wodanium. The mineral is now known as Gersdorffite.

CRODONIUM.

J. B. Trommsdorff, not discouraged by his ill success with Agusterde, announced in 1820 the discovery of another element, which he extracted from the incrustation on a carboy of sulphuric acid imported from England. The name Crodonium is from *Crodo*, an idol held in veneration by the ancient people of Thuringia, the capital of which (Erfurt) was Trommsdorff's adopted town. Having worked up all his material, he experienced much difficulty in finding any acid having a similar deposit, but at length secured sufficient to ascertain that it consisted of lime and magnesia rendered impure with iron and copper.

PLURANIUM, POLINIUM, AND RUTHENIUM.

In 1828 Osann attempted an extended investigation of platinum ores from the Ural Mountains. His researches do not appear to have been characterized by great accuracy, for they resulted in the discovery of three defunct elements—Pluranium, Polinium, and Ruthenium. These elements were of very brief existence, and but little interest is attached to their short career; the derivation of their names, however, has been recorded: Ruthenium from Ruthenia, the ancient name of Russia; Pluranium from the first portions of Platinum and Ural; and Polinium from πολιός, gray.

The element now called Ruthenium was discovered in 1844 by Claus, who showed that Osann's Ruthenium consisted of a mixture of silicic and titanic acids, with alumina, iron oxide, and a small portion of the true metal.

DONIUM.

In 1836 Davidson submitted a mineral, found near Aberdeen, Scotland, to his friend Prof. Thomson for analysis; the latter found the so-called Davidsonite to contain 66% silica, 32% alumina, and 1·3% water, which calculation gives 2½ atoms of silica to one of alumina.

Thomas Richardson, remarking the improbability of this proportion, examined the mineral, and came to the conclusion that it contained, besides alumina, the oxide of a new metal, and he named it Donium, a contraction of Aberdonia, the classical name of Aberdeen. Richardson described a brown and a white oxide, and the metal

itself. Thomson again analyzed the mineral, and showed that Donium oxide was but a mixture of alumina and iron oxide, remarking at the same time an anomaly with reference to the solubility of the earth in ammonia, this being one of the reactions claimed by Richardson as peculiar to Donia.

It appears that neither of these chemists were acquainted with glucina (discovered in 1798), for, some years after, Heddle explained the anomaly by finding this earth in the mineral in question. Dana says Davidsonite is a greenish-yellow beryl.

TREENIUM

Was discovered in 1836, by Boase, in a mineral occurring in decomposed granite at Treene, Land's End. The oxide is described as soluble in potash, and precipitable by chloride of ammonium; it formed an alum, and in this respect resembled alumina. On the other hand, it was soluble in ammonia, and formed two oxides, a white and a brown. Boase thought that it was possibly identical with Richardson's Donium, discovered in the same year.

Further notice of this element, if any exists, has been overlooked.

TERBIUM.

In 1794 Gadolin discovered Yttria in a mineral from Ytterby, Sweden. In 1843 Mosander, another Swede, discovered in Gadolinite two new elements which he called Terbium and Erbium, the names, like Yttrium, being derived from Ytterby—Terbium by dropping the initial "Y," and Erbium by dropping the initial "T" of the last named—a truly original way of christening elements. The existence of Terbium long remained unchallenged, though no method for effecting a perfect separation from Erbium was discovered, a fact which occasioned little suspicion, however, on account of the exceeding difficulty of purifying any of the oxides of this group.

In 1860 Berlin pronounced Terbium to have no existence, and attributed Mosander's errors to the presence of traces of uranium and glucinum.

PELOPIUM.

In 1801 Hatchett discovered Columbium in an American mineral; in the following year Eckeberg discovered Tantalum in a Swedish mineral. Wollaston pronounced these elements identical, and this opinion was generally received until 1846, when Heinrich Rose showed that the American mineral contained the oxides of two metals, both different from that furnished by Tantalite; these he called Niobium and Pelopium, from the children of Tantalus.

These two elements were chiefly distinguished by the reactions of their acids and the nature of their chlorides, that of Niobium being white, volatile, and infusible, while that of Pelopium was yellow, volatile, and fusible. Rose found by subsequent investigation that the two acids were indirectly convertible one into the other, and clearly proved that they contained the same metal, associated with different quantities of oxygen; pelopic acid becoming niobic acid, and niobic acid hyponiobic acid.

Some chemists retain the original name Columbium —and as Americans we have the undoubted right so to do—in which case Niobium becomes one of the defunct elements.

ILMENIUM

Was discovered in 1846 by Hermann. Its history is connected with that of Niobium and Pelopium. H. Rose and Hermann have carried on both the investigation and the controversy, the former contending that ilmenic acid acid was but niobic mixed with tungstic and pelopic;—this Hermann finally admitted.

ARIDIUM

Was discovered by Ullgren in 1850, in chrome iron ore from Röras. As the metal closely resembled iron, he called it Aridium, from ἄργης and εἶδος. Bahr repeated Ullgren's experiments with wholly negative results, since which time nothing has been heard of Aridium.

DONARIUM

Was discovered by Bergemann, in 1851, in Orangite, a mineral containing as high as 71% of the new oxide. Donaria was said to resemble Zirconia, but was of a deep red color; its specific gravity = 5·57. Bergemann described a great many of its compounds, prepared the metal itself, and estimated its atomic weight = 79·71, the oxide having the formula Do_2O_3.

Damour investigated this subject, and remarked that all the properties of Donaria described by Bergemann were common to Berzelius' thorina, except the color and the specific gravity. Finding the specific gravity of the earth extracted from Orangite = 9·36 (that of thorina being 9·4), and attributing the red color to the presence of oxides of lead and uranium, Damour denied the existence of Donaria.

Berlin, who has played the executioner's part with these elements, also maintains the identity of Donarium and Thorinum, and finally Bergemann himself acknowledges this to be probable.

Dana calls Orangite a light-colored variety of Thorite.

THALIUM.

In 1852 Owen discovered, in a magnesian mineral from the northern shores of Lake Superior, an oxide to which he gave the name Thalia. It bore some resemblance to magnesia, but formed green and yellow solutions. Thalit was examined by J. Lawrence Smith and by Genth, who satisfactorily showed that it was a variety of Saponite, and the earth a mixture of magnesia and lime.

DIANUM.

The Bavarian mineralogist Von Kobell, while engaged in analyzing Tantalite from different localities, remarked certain peculiarities in that from Finland, which he attributed to the presence of a new metallic acid, Dianic acid. He distinguished it from niobic and tantalic acids by the formation of a deep sapphire blue solution when treated with tin and hydrochloric acid; Von Kobell afterwards found Dianic acid in Samarskite, Euxenite, and other minerals.

Heinrich Rose examined material sent him by Von Kobell, and attributed the production of a blue color to a trace of tungstic acid. Von Kobell answered with new proofs; St. Clair Deville, Rose, and Hermann separately attacked Von Kobell's views, and to each he replied, thus giving rise to a lengthened discussion upon which it is unnecessary to dwell.

Dianum is now generally classed among the defunct elements.

WASIUM

Was discovered by Bahr, in 1862, in a variety of Allanite, the same mineral which gave rise to Junonium. This mineral (also known as Orthite) contains thirteen

or more oxides, including those of cerium, lanthanium, didymium, yttrium, thorinum, uranium, and tantalum; it is not surprising, therefore, that such a combination of rare earths should occasion errors of this nature.

Delafontaine, and afterwards Bahr himself, concluded that Wasium oxide was but a mixture of thorina and yttria.

(To be continued.)

The Various Methods for the Determination and Separation of Baryta, Strontia, and Lime.

BY PAUL SCHWEITZER, PH.D.

(Continued from the May Number.)

IV. Separation of Baryta from Strontia.

The methods we have for separating the alkaline earths from each other cannot be counted among the most accurate in analytical chemistry. In fact, several of them are very imperfect, and can only be recommended for such purposes conditionally, as is the case with the three principal methods for separating baryta from strontia. Those three methods are based, as we shall see hereafter, on very few or no analyses at all, and do not bear the close scrutiny of the analyst. The separations are founded on the different deportment of similar and very nearly related salts, and give, therefore, as is always the case under such circumstances, tolerable results when the quantity does not influence the decomposition, that is, when the substances in a solution are nearly in the proportion of the forces of their affinities. This quantity action is well illustrated by almost all the salts of the alkaline earths, and has played a more important part than we generally suppose in the chemistry of geological phenomena.

Separation by means of Carbonate of Ammonia.

This method of acting on the sulphates of the alkaline earths with carbonate of ammonia, and removing the carbonate formed from the remaining sulphate, was first proposed by H. Rose, who, in a very interesting paper (Pogg. Ann., vol. 95, p. 286, 1855), gave his results of an investigation on the differences existing between the alkaline earths in their combination with carbonic and sulphuric acid. All the figures given there are instructive, but the number of separations actually made of the sulphates amounted only to three, and of these only one was made by means of carbonate of ammonia. The conditions under which the analyses were made were the most favorable possible. Other printed records of comparative analyses according to this method, I have not been able to find, and so it seems as though the method rested on this hardly satisfactory basis. The minerals of the alkaline earths contain generally large quantities of the one mixed with very small amounts of the others, which small amounts have to be determined accurately. In the two following analyses the latter case was chosen; chloride of barium and nitrate of strontia, after solution in water, were precipitated completely with dilute sulphuric acid, ammonia then added to alkaline reaction, and the whole digested for thirty-six hours with a sufficient amount of carbonate of ammonia; this had been made by dissolving carbonate of ammonia in cold water. The analyses were finished as described in "Fresenius's Quantitative Analysis," and I will only remark, that the mixed carbonates and sulphates are best washed twice by decantation before bringing them upon the filter. This will prevent their running through, but the last wash-waters are caught advantageously in a clean and empty beaker, in case it should be found necessary, to filter a second time.

1. 2·0680 BaCl (= 2·3174 BaO,SO_3)
   0·2240 SrO,NO_5
   Results obtained after weighing.
   2·3330 BaO,SO_3
   2·0819 BaCl = 100·76 p. c.
   0·1270 SrO,CO_2
   0·1821 SrO,NO_5 = 81·38 p. c.
   2·3330 BaO,SO_3 obtained.
   2·3174 " " present.

   0·0156 SrO,SO_3 = 0·0180 SrO,NO_5
   0·1821 " "
   0·2001 " = 89·33 p. c.

2. 0·1885 BaCl
   2·0950 SrO,NO_5 (= 1·4610 SrO,CO_2).
   Results obtained after weighing.
   ——— BaO,SO_3
   1·6330 SrO,CO_2
   2·3416 SrO,NO_5 = 111·77 p. c.
   1·6330 S_2O,Co_2 obtained.
   1·4610 " " present.

   0·1720 BaO,CO_2 = 0.1815 BaCl = 96·29 p. c.
   Results calculated to 100.

1.	90·23 BaCl found	90·83	calculated 90·23
	9·77 SrO,NO_5	5.54	8·73
		96·37	98·96
2.	8.25 BaCl found	———	calculated 7·95
	91·75 SrO,NO_5 "	102·55	" 91·75
		102·55	99.70

These two analyses gave quite unsatisfactory results. The great quantity of one constituent of the mixture influenced the other; in one case preventing the total decomposition of the sulphate of strontia, in the other favoring the decomposition of the sulphate of baryta, which outside of the influence of this action would have taken place as in the substances alone. The doubt, however, arose, whether a large amount of sulphate of ammonia had any effect in retarding or preventing the conversion of the sulphate of strontia into carbonate, and whether a concentrated solution of carbonate of ammonia was without effect on sulphate of baryta. To determine this point, pure sulphate of strontia was prepared, and, while yet wet, digested with carbonate of ammonia, to which some caustic ammonia and a very large amount of sulphate of ammonia had been added. After two days' standing the precipitate was filtered off, washed out completely, and treated with hydrochloric acid, wherein it dissolved without leaving any residue. Pure sulphate of baryta was then treated with a concentrated solution of carbonate of ammonia for two days, when it also was washed and treated with hydrochloric acid; this hydrochloric acid solution showed no indications whatever of baryta. If, however, the sulphate of baryta is boiled with carbonate of ammonia, some carbonate of baryta is formed, as has been mentioned already by H. Rose. A very large amount of sulphate of ammonia to little sulphate of strontia will render the action of the carbonate of ammonia rather slow; but a twofold treatment will always convert all sulphate of strontia into carbonate.

Not being satisfied, then, with the above two analyses,

and wishing to determine the margin at which in a mixture perfect decomposition takes place, eight other analyses were undertaken and finished with the greatest care. The carbonate of ammonia acted for about four days on the sulphates, which were stirred up several times, and the analyses completed then in the usual manner with the following results:—

1. 3·0150 BaCl (= 3·3787 BaO,SO_3)
0·1490 SrO,NO_5
obtained 3·4740 BaO,SO_3
3·1001 BaCl = 102·16 p. c.
0·0035 SrO,CO_2
0·0050 SrO,NO_5 = 3·35 p. c.

3·4740
3·3787

0·0953 SrO,SO_3 = 0·1098 SrO,NO_5 = 77·05 p. c.

2. 3·0395 BaCl (= 3·4061 BaO,SO_3)
0·4455 SrO,NO_5
obtained 3·7080 BaO,SO_3
3·3089 BaCl = 108·86 p. c.
0·0305 SrO,CO_2
0·0437 SrO,NO_5 = 9·81 p. c.

3·7080
3·4061

0·3019 SrO,SO_3 = 0·3479 SrO,NO_5 = 78·09 p. c.

3. 2·7435 BaCl (= 3·0744 BaO,SO_3)
1·5235 SrO,NO_5
obtained 3·5390 BaO,SO_3
3.1580 Ba Cl = 115·11 p. c.
0·6695 SrO,CO_2
0·9600 SrO,NO_5 = 63·01 p. c.

3·5390
3·0744

0·4646 SrO,SO_3 = 0·5555 SrO,NO_5 = 35·15 p. c.

4. 2.4765 BaCl (= 2·7752 BaO,SO_3)
2·1845 SrO,NO_5
obtained 3·2770 BaO,SO_3
2·9242 BaCl = 118·07 p. c.
1·0940 SrO,CO_2
1·5687 SrO,NO_5 = 71·37 p. c.

3·2770
2·7752

0·5018 SrO,SO_3 = 0·5784 SrO,NO_5 = 26·48 p. c.

5. 1·6460 BaCl (= 1·8445 BaO,SO_3)
2·6830 SrO,NO_5
obtained 2·1920 BaO,SO_3
1·9560 BaCl = 118·83 p. c.
1·5705 SrO,CO_2
2·2520 SrO,NO_5 = 83·94 p. c.

2·1920
1·8445

0·3475 SrO,SO_3 = 0·4005 SrO,NO_5 = 14·93 p. c.

6. 0·7870 BaCl (0·8819 BaO,SO_3)
2·3790 SrO,NO_5
obtained 0·9740 BaO,So_3
0·8691 BaCl = 110·43 p. c.
1·5825 SrO,CO_2
2·2691 SrO,NO_5 = 95·38 p. c.

0·9740
0·8819

0·0921 SrO,SO_3 = 0·1061 SrO,NO_5 = 4·46 p. c.

7. 0·4290 BaCl (= 0·4807 BaO,SO_3)
3·0805 SrO,NO_5
obtained 0·5250 BaO,SO_3
0·4685 BaCl = 109·20 p. c.
2·1135 SrO,CO_2
3·0306 SrO,NO_5 = 98·83 p. c.

0·5250
0·4807

0·0243 SrO,SO_3 = 0·0280 SrO,NO_5 = 0·91 p. c.

8. 0·0755 BaCl
3·0125 SrO,NO_5(= 2·1009 SrO,CO_2)
obtained 0·0770 BaO,SO_3
0·0689 BaCl = 90·99 p. c.
2·1100 SrO,CO_2
3·0255 SrO,NO_5 = 100·43 p. c.

2·1100
2·1009

0·0091 BaO,CO_2 = 0·0096 BaCl = 12.71 p. c

It will not be necessary to comment on these analyses. I only may add, that it is difficult to keep the mixed carbonates and sulphates from running through the filter. This was especially noticeable where there was much baryta in a mixture, so that number 8 filtered better than number 7, this better than 6, and so forth down to number 1. The mixtures with much baryta had to be washed longer than the others, as the sulphate of baryta in alkaline solutions retains sulphuric acid. In calculating the results of the foregoing analyses to 100, we obtain the following figures:

1. 95·29 BaCl
4·71 SrO,NO_5

found =	97·98 BaCl calculated	95·29
	0·16 SrO,NO_5	3·63
	98·14	98·92

2. 87·22 BaCl
12·78 SrO,NO_5

found =	94·95 BaCl calculated	87·22
	1·25 SrO,NO_5	11·24
	96·20	98·46

3. 64·30 BaCl
35·70 SrO,NO_5

found =	74·01 Ba Cl calculated	64·30
	22·49 SrO,NO_5	35·05
	96·50	99·35

4. 53·14 Ba Cl
46·86 SrO,NO_5

found =	62·74 Ba Cl calculated	53·14
	33·66 SrO,NO_5	46·06
	96·40	99·20

5. 38·02 Ba Cl
61·98 SrO,NO_5

found	45·19 Ba Cl calculated	38·02
	52·02 SrO,NO_5	61·27
	97·21	99·29

6. 24·86 Ba Cl
75·14 SrO,NO_5

found	27·45 Ba Cl calculated	24·86
	71·67 SrO,NO_5	75·02
	99·12	99·88

7. 12·22 Ba Cl
87·78 SrO, NO_5

found	13·35 Ba Cl calculated	12·22
	86·35 SrO, NO_5	87·15
	99·70	99·37

8. 2·44 Ba Cl
97·56 SrO, NO_5

found =	2·23 Ba Cl calculated	2·54
	97·98 SrO, NO_5	97·56
	100·21	100·10

Not wishing to relinquish this method of separation, I tried to modify it, and thereby obtain perhaps better results. Three more analyses were made, in which, after standing over night, the clear solution was poured through a filter, and the residue digested again with fresh carbonate of ammonia. This was repeated three times, taking altogether three days, before the residue was brought upon the filter and washed; the filtrates were tested each day for sulphuric acid, which proved after the second day to be more in 1 than in 2 and 3, which contained about equal quantities; and after the third day only minute traces were found in all three filtrates. After washing completely, and dissolving the carbonate in hydrochloric acid, number 1 filtered a great deal better than 2 and 3, which in fact had to be filtered twice, before clear solutions could be obtained.

The results were as follows:—

1. 1·8015 Ba Cl (= 2·0188 BaO,SO_3)
0·2840 SrO,NO_5
obtained 2·0810 BaO,SO_3
1·8570 BaCl = 103·08 p. c.
0·1175 SrO,CO_2
0·1685 SrO,NO_5 = 59·33 p. c.
2·0810
2·0188
0·0622 SrO,SO_3 = 0·0717 SrO,NO_5 = 25·25 p. c.

2. 1·5400 BaCl
1·6395 SrO,NO_5 (= 1·1434 SrO,CO_2)
obtained 1·6030 BaO,SO_3
1·4305 BaCl = 92·89 p. c.
1·2260 SrO,CO_2
1·7579 SrO,NO_5 = 107·22 p. c.
1·2260
1·1434
0·0826 BaO,CO_2 = 0·0872 BaCl = 5·66 p. c.

3. 0·2845 BaCl
1·8500 SrO,NO_5 (= 1·2902 SrO,CO_2)
obtained 0·2370 BaO,SO_3
0·2115 BaCl = 74·34 p. c.
1·3570 SrO,CO_2
1·9458 SrO,NO_5 = 105·18 p. c.
1·3570
1·2902
0·0568 BaO,CO_2 = 0·0705 BaCl = 24.79 p. c.

The results, calculated to 100, are as follows:—

1. 86·38 BaCl
13·62 SrO,NO_5

found	89·04 BaCl calculated	86·38
	8·08 SrO,NO_5	11·52
	97·12	97·90

2. 48·44 BaCl
51·56 SrO,NO_5

found	44·99 BaCl calculated	47·73
	55·29 SrO,NO_5	51·56
	100·28	99·29

3. 13·33 BaCl
86·67 SrO,NO_5

found	9·91 BaCl calculated	13·22
	91·16 SrO,NO_5	86·67
	101·07	99 89

An analysis conducted in this way proves plainly that carbonate of ammonia acts upon sulphate of baryta. We have therefore to distinguish whether in a mixture of baryta and strontia the former or latter predominates; in the first case alone it might be well to digest the mixture twice with carbonate of ammonia, while in the latter case a single digestion would give the best results. The error in all the foregoing analyses will be correspondingly smaller when the results are calculated to caustic baryta and strontia; but this is only a slight satisfaction when for any special purpose exceedingly small amounts of one of them have to be separated from a very large amount of the other.

Adulterated Lard.

The adulteration of lard with water is now so well understood by merchants that the wholesale price is regulated by the nominal percentage of the adulterant. For lard sold as containing eight per cent of water, a deduction of eight per cent from the price of pure lard is allowed, and so on. Unfortunately, however, the buyer, having no ready method for determining the percentage of water, is compelled to accept the statement of the manufacturer; and we are sorry to find that the percentage of water is often understated. A lot of lard sold for exportation as containing eight per cent of water, was found by us to contain sixteen, a difference of eight per cent. This percentage of fraud is probably considerably greater than the shipper's profit. It is said that as much as thirty per cent of water is sometimes present; we have found twenty-one per cent in a sample. It should be remembered that although the fraud is thus partially understood by the dealers, it is not known to the consumer, who buys lard containing often one-fourth its weight of water for pure lard.

The presence of water is very easily detected by merely melting the lard, when the water collects at the bottom of the vessel as a distinct layer.

To determine the exact percentage of water we weigh out 100 grammes of the sample, melt it in a beaker placed in hot water, and when melted pour it into a cylinder graduated in cubic centimetres. It is advantageous to place the cylinder in hot water for a few minutes, till the separation of water and lard is

complete. The percentage of water is then read off on the scale.

This test may be made by any person of ordinary intelligence. It thus appears that oil and water can be made to mix, provided there is a pecuniary advantage in the operation.

Combining Power of Phosphoric Acid.

CAMBRIDGE, June 1st, 1870.

DEAR CHANDLER:—

In the course of my researches upon phosphoric acid, I have arrived at certain results which have a scientific interest that I am sure you will appreciate. Among other things, I produced, sixteen years ago, compounds, dry, non-hydroscopic, and crystalline, in which the number of atoms of lime to phosphoric acid was in the ratio of $5CaO$ to $6PO_5$. In the interval since then I have made numerous other compounds of lime and phosphoric acid, in which the ratio of acid was still higher. About a year since I obtained a compound, dry, crystalline, and non-hydroscopic, in which there was but one atom of lime to three of phosphoric acid. Since then I have succeeded in obtaining a dry nonhydroscopic phosphoric acid, containing this acid and water only; and my friend Dr. Genth, in following my directions, has repeatedly obtained in beautiful crystals the compound PO_5+5HO, with only a trace of impurity.

I have found that when phosphoric acid solution, under certain well-defined conditions, is concentrated till the solution contains twenty-four atoms of water to one of acid, and then mixed with one and one-half atoms of starch ($C_{12}H_{10}O_{10}$), a thoroughly dry, non-hydroscopic powder is obtained on drying, in which fourteen of the twenty-four atoms of water are replaced by starch. On the other hand I have repeated Miller's experiments, made to determine whether phosphoric acid would combine with more than three atoms of lime to one of acid. Miller employed saccharate of lime, and obtained an excess of lime over three atoms, which Erlenmeyer suggested might be due to hydrate of lime. I find, however, that when hydrated tribasic phosphate of lime is boiled with lime-water, it takes up lime in excess of four atoms of lime to one of acid; and the powder contains water of crystallization, and does not indicate with test paper the slightest alkaline reaction.

Pure precipitated $3CaO,PO_5+Aq$ after being dried, gives, on the addition of water, an acid reaction, although precipitated in the presence of a large excess of ammonia, and shown by analysis to contain $3CaO$ to $1PO_5$.

It was my fortune, I believe, to be the first who made a *dry non-hydroscopic*, monocalcic orthophosphate (biphosphate of lime).

I may sum up the above in the following formulæ, as exhibiting my results:—

$$CaO,2HO,PO_5+Aq$$
$$5CaO,6PO_5+Aq$$
$$5CaO,8PO_5+Aq$$
$$5CaO,12PO_5+Aq$$
$$CaO,3PO_5+Aq$$
$$PO_5+Aq$$
$$4CaO,PO_5+Aq$$

all of these compounds being obtained in a dry, non-hydroscopic form. At no distant period I hope to have the pleasure of submitting a paper containing the numerical data on which the above calculations rest, together with other matters connected with this most interesting acid. I am, faithfully yours,

E. N. HORSFORD.

Blowpipe Attachment to Bunsen's Filtering Water Air-Pump.

GEORGE W. RAINS, M.D., Professor of Chemistry at the Medical College of Georgia, sends us a drawing of a blowpipe attachment to the water air-pump which we should be glad to present did our space permit. It is designed to supply a blowpipe with the air which is impelled by the water current. The attachment is connected with the fall-pipe of the Bunsen's filtering apparatus, and the stream of air and water is forced to enter it by the closing of a cock situated below the point of attachment. The apparatus consists of an open vessel, in which is placed a smaller vessel closed at the top, but provided with three openings: two on the top, one for the entrance of the air and water, the other for the exit of the air to supply the blowpipe. The third opening is on the side near the bottom, for the escape of the water. As the water fills the outer vessel and flows over its rim, the air in the inner reservoir is subjected to the pressure of a column of water equivalent to the depth of the outer vessel.

The contrivance is very simple, and will furnish a continuous jet of air for the blowpipe, or for any other object.

The Geyser Spring at Saratoga, N. Y.

THE Spouting Spring or Geyser was obtained last winter by boring. At a depth of 160 feet, a crevice was penetrated from which the water has continued to issue ever since. Four or five times a minute the jets shoot up, striking the ceiling of the room of Vale & Seavey's bolt factory, in which the boring was made. The spring is located a mile and a half south of the village of Saratoga Springs, on the Ballston road. An analysis of the water made by the editor, with the aid of Mr. F. A. Cairns, gave the following results:—

Chloride of Sodium	562·080	grains.
Chloride of Potassium	24·634	"
Bromide of Sodium	2·212	"
Iodide of Sodium	0·248	"
Fluoride of Calcium	trace	
Bicarbonate of Lithia	7·004	"
Bicarbonate of Soda	71·232	"
Bicarbonate of Magnesia	149·343	"
Bicarbonate of Lime	170·392	"
Bicarbonate of Strontia	0·425	"
Bicarbonate of Baryta	2·014	"
Bicarbonate of Iron	0·979	"
Sulphate of Potassa	0·318	"
Phosphate of Soda	trace	
Biborate of Soda	trace	
Alumina	trace	
Silica	0·665	"
Organic matter	trace	
Total solid contents	991·546	"
Carbonic Acid Gas in 1 U. S. Gal.	454·082	cub. in.
Density	1.011	
Temperature	46°	Fah.

Recent Chemical Patents.

Issued April 19, 1870.

101,969.—Manufacture of Steel from Cast or Pig Iron.—H. M. Baker, Washington, D. C.

102,018.—Apparatus for Removing Oils, Grease, Gums, and the Like from Cotton and Woollen Waste, and Recovering the Same.—J. W. Kupps, Chicago, Ill.

* 102,030.—Method of Treating Tracing Paper.—Julius Moog, Karlsruhe, Germany.

102,135.—Treating Paraffine and obtaining it in Crystals.—Frederick Lambe, London, England.

102,146.—Manufacture of Steel.—Charles Motier Nes, York, Pa.
102,148.—Treating Tin Scrap to obtain Useful Products.—D. D. Parmelee, N. Y. City.
102,198.—Bronzing and Gilding.—J. L. Duffee, Washington, D. C.

Issued April 26, 1870.

102,203.—Apparatus for Mixing Hydrogen and Air.—Daniel Ash, Wappingeis Falls, N. Y.
102.205.—Concentrating Oil of Vitriol.—W. H. Balmain, St. Helen, Great Britain.
102,239.—Apparatus for Separating Wood Fibre for Paper, etc.—Albert Fickett, Rochester, N. Y.
102,265.—Manufacture of Paper.—Isaac Hoffman, Oregon, N. Y.
102,268.—Manufacture of India-Rubber Belt.—Albert H. Hook, N. Y. City.
102,324.—Manufacture of Alloys of Manganese.—Elliot Savage, West Meriden, Conn.
102,378.—Coating and Bronzing Iron.—Lansing Dockstader, West Meriden, Conn.
102.387.—Manufacture of Yeast.—Henry Fleishmann, N. Y. City.
102,438.—Manufacture of Fertilizers.—W. J. Sapp, Baltimore, Md.
102,450.—Preventing Mildew and Decay in Sails, Awnings, Tents, Tarpaulins, and other Articles and Fabrics.—W. A. Torrey, Mount Clair, N. J.

Issued May 3, 1870.

102,546.—Manufacture of Soap.—Charles Wager Hull, N. Y. City.
102,550.—Process for Tempering Steel.—Jabez Jenkins, Philadelphia, Pa.
102.570.—Compound for Dressing Textile Fabrics.—John McGill, Boston, Mass.
102,633.—Evaporating and Distilling by Solar Heat.—Norman W. Wheeler, Brooklyn, L. I.
102,648.—Drying Guano.—Edwin P. Baugh, Philadelphia, Pa.
102.689.—Manufacture of Fertilizer and Oil from Fish.—Orazio Lugo, Baltimore, Md.
102,715.—Compound for Refining Cider, Wine, &c.—Oliver Schaffer, Dayton, Ohio.
102,740.—Manufacture of Wrought Iron from Ore, Cinder, or Slag.—James D. Whelpley and Jacob J. Storer, Boston, Mass.

Issued May 10, 1870.

102,748.—Electro Deposition of Nickel.—Isaac Adams, Jr., Boston, Mass.
102,760.—Bleaching, Tanning, and Coloring Sponges.—Frederick Braun and A. T. Schmidt, Pittsburgh, Pa.
102,774.—Distilling Turpentine.—David Cashwell, Wilmington, N. C.
102,796.—Manufacture of Steel.—William Fields, Wilmington, Del.
102,797.—Manufacture of Iron.—William Fields, Wilmington, Del.
102,819.—Apparatus for Distilling Hydrocarbon Oils.—S. A. Hill and C. F. Thumm, Oil City, Pa.
102,824.—Acid and Water-proof Composition for Coating Cloth, &c.—H. W. Johns, N. Y. City.
102,832.—Apparatus for obtaining Tanning Extracts.—Simon H. Kennedy, N. Y. City.
102,868.—Bleaching Straw Goods.—A. M. Rosbrugh, Panora, Iowa.
102,869.—Preserving and Hardening Stone, Brick, &c.—E. J. Salisbury, San Francisco, Cal.
102,906.—Manufacture of Soap.—H. M. Baker, Washington, D. C.
102,912.—Manufacture of Iron and Steel.—J. P. Budd, Ystalyfera, near Swansea, Wales.
102,960.—Reworking Bessemer Steel.—Charles Motier Nes, York, Pa.
102,969.—Manufacture of Sugar.—Juan Poey, Havana, Cuba.
102,986.—Apparatus and Process for Refrigerating, Preserving, and Ventilating.—D. E. Somes, Washington, D. C.

Reissues.

3,921.—Treating Organic Materials with Air.—Rudolph D'Heureuse, N. Y. City.
3,959.—Manufacture of Yeast for Distillers.—Joseph Wolff, Cincinnati, Ohio.
3,962.—Bronzing and Gilding.—John L. Duffee, Washington, D. C.

Extensions.

Pulverulent Acid for Use in the Preparation of Soda Powders Farinaceous Food, and other Purposes.—E. N. Horsford, Cambridge, Mass.

NEW PUBLICATIONS.

Report of Prof. W. E. Aikin, Inspector of Illuminating Gas for the City of Baltimore, on the Comparative Value of different Gas-burners. May 9, 1870.

This report embodies the results of the careful examination of eighty-two burners, of which thirty-six were *union jet* burners, thirty-seven *bat-wing* burners, and seven *argands*. We regret that an additional column, showing the candle-powers for the same consumption of gas, or the consumption for the same candle-power, was not added to the otherwise very complete record of the experiments. We hope to be able to print the report in full in our next issue.

BREVITIES.

The Lyceum of Natural History.—At the meeting of the Chemical Section, held May 9th, the following papers were read:—
Prof. Charles A. Seely: On the Constitution of Ammonium Amalgam.
Dr. Isidor Walz: Laboratory Notes.
May 16th.
Dr. H. C. Bolton: On the Rise and Fall of Defunct Elements.
Mr. F. Prime, Jr.: On the Metallurgy of Argentiferous Galena.
Prof. J. S. Newberry: On the Ancient Lakes of Western North America, their Deposits and Drainage.

Naphthaline, which occurs in large quantities in the waste of gas-works, and has always been rejected as worthless, is found by Prof. Asa Gray to be an admirable substitute for camphor, as a protection against moths and other insects.

Prof. Frederic Stengel has been elected teacher of German, and Prof. J. E. Loiseau, teacher of French, in the Columbia College School of Mines.

Salt at Alpena.—We have seen a specimen of the salt taken out of the well at Alpena, with the sand pump, at a depth of about 1,100 feet, which is, to all intents and purposes—save bearing a tinge of the rocky sediment worked off the walls of the well, which gives it a bluish color—pure salt; remarkably free from the pungent taste which the chlorides impart to the brine as at first found in many localities, purely and essentially rock salt. Of the importance of this discovery, in view of the fact that it costs the mills at Alpena thousands of dollars annually to burn up their sawdust, slabs, edgings, and débris, and that the port of Alpena is only fifteen miles off the regular course of Chicago bound vessels, we have before this had something to say; and it being thus settled that Alpena is to become an important salt-producing locality, will have much to do, as well with the prosperity of that thriving locality as with the general business of manufacturing salt in the Saginaw Valley and on "the Shore."

ANSWERS TO CORRESPONDENTS.

Adulterations of Sugar and Molasses.—We reply to *A Subscriber* that acetate of lead is not, to our knowledge, ever used in sugar refining. The basic acetate of lead is universally used in the laboratory for testing sugar in connection with the polariscope. Its use in refining was proposed in England by Scoffern, but was never accepted on account of the danger of leaving it in the sugars or syrups. Ultramarine is used universally in England, France, Germany, and America, and is entirely harmless. Grape sugar is used on the continent for extending the syrups, and is in no way objectionable. The other agent you mention has been used in this country by a few refiners, so far as we know, in quantities so small as to be unobjectionable.—Editor.

Dental Vulcanite and Iodized Rubber.—These preparations for plates for artificial teeth differ materially. *Dental Vulcanite* is composed of India-rubber, sulphur, and vermilion, and when baked owes its hardness to the action of the sulphur. Its manufacture is covered by the Goodyear Hard Rubber Patent. *Iodized Rubber* is prepared under the patents of Newbrough and Fagan. It is a mixture of India-rubber, iodine, and vermilion, containing generally kaolin or some other inert substance, and a small quantity of sulphur. When oxide of iron is used as a coloring agent in place of vermilion, no sulphur is added. The hardening of this compound is due to the action of the iodine on the rubber. The iodized rubber has been the subject of an interesting lawsuit, on the ground that its manufacture was an infringement of the Goodyear Hard Rubber Patent. As the plaintiffs compromised the suit, it seems that they accepted the testimony of the defendants' chemists, who claimed that the hardening was due to the iodine.

Bartlett's White Lead.—This pigment differs entirely from ordinary white lead, which is a carbonate of lead. It is a very intimate mixture of oxide of zinc and sulphate of lead, which is produced from an ore found at the Stewart Mine, near Charlotte, North Carolina. The ore is a compact mixture of zinc blende and galena. It is roasted at the mine, shipped to Bergen Point near New York, and there reduced in peculiar furnaces. The roasting changes ZnS to ZnO, and PbS to PbO,SO_3. The reduction changes ZnO to Zn, and PbO,SO_3 to PbS. These products rise in vapor and are oxidized by a current of air to ZnO and PbO,SO_3, which are collected in a system of cotton bags, and constitute the *Bartlett White Lead*.

It is an interesting fact that the roasted ore yields to water a quantity of sulphate of cadmium; this may become a very important source of this somewhat rare metal.

The following analysis of Bartlett White Lead was made by Prof. C. P. Williams, and published in the Journal of the Franklin Institute for March, 1869.

Oxide of Zinc	72·083
Oxide of Iron	trace.
Oxide of Antimony	trace.
Oxide of Lead	0·274
Sulphate of Lead	23·968
Sulphate of Zinc	0·810
Chloride of Zinc	0·839
Chloride of Iron	0·071
Terchloride of Antimony	trace.
Chloride of Cadmium	0 256
Moisture	0·398
	98·699

QUESTIONS FROM CORRESPONDENTS.

Nitro-Glycerine.—What is the explosive power of Nitro-glycerine as compared with gun-powder? *Engineer.*

Lead in Potable Water.—I have had some difficulty in the quantitative estimation of small quantities of lead in city water. What is the best method for accurate estimation? *W. T. S.*

Potash from Feldspar.—Why has not the manufacture of potash from feldspar been prosecuted? What are the obstacles to its success? *Engineer.*

Glove Stains.—Will some one tell me an easy method of removing mildew spots from kid gloves? *A. B.*

THE

CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE:

(WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE.")

A Journal of Practical Chemistry

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

WILLIAM CROOKES, F.R.S.

AUTHORIZED AMERICAN REPRINT, VOLUME VI.—JANUARY TO JULY, 1870.

NEW YORK:
W. A. TOWNSEND & ADAMS, PUBLISHERS.

M DCCC LXX.

VOLUME VI., AMERICAN REPRINT,

BEING PARTS OF

VOLUMES XX., XXI., VIZ. NUMBERS 519-544,

OF THE ENGLISH EDITION.

THE NEW YORK PRINTING COMPANY,
81, 83, *and* 85 *Centre Street*,
NEW YORK.

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